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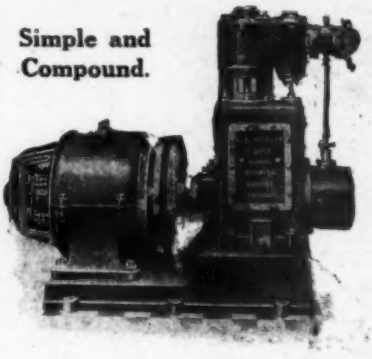

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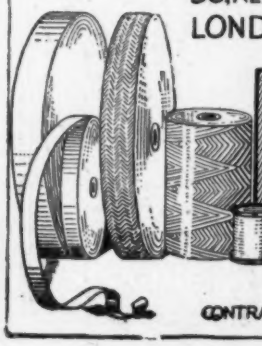

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ELECTRICAL REVIEW.

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PRODUCTION DATA IN WAR-TIME.

SOME of the commonplaces of war-time in which we are prone to find relief for vexation and pent-up feelings of irritation are aimed at the infringement of individual liberties, at Governmental control, and at the multiplicity of statistical returns that we are called upon to render. We are conscripted in the present for the grand purpose of preserving for the foes of Prussianism the ultimate freedom which we regard as the heritage of democratic peoples. Temporarily we suffer what we may comprehensively term inconvenience, in the fixed determination that threatening shackles shall never bind us permanently. We offer our criticisms and our protests concerning "interference," inquisition, excessive tabulation, and so forth, because we must somehow give vent to the feeling that we are living in the most impossible of worlds, yet deep down we recognise that we are in the throes of a war which inevitably cuts right to the heart of everything, and places upon us burdens of change in regard to established systems at home, just as it changes absolutely the lives of millions of fighting men. Not that we would condone in the least degree the desires of men in authority to be officious and unduly inquisitorial, increasing our work and strain unnecessarily when experienced men are away; but we have respect for the view that for nations that have during a long period developed their methods individually, and more or less evolutionarily, the change-over to co-ordination and maximum mass efficiency for the purposes of war must impose conditions that under normal circumstances would never have been tolerated in imagination, much less borne in actual practice.

In pre-war days, when each manufacturer in an industry was free to "gang his ain gait," some were content with out-of-date methods so long as sufficient business could be secured to ensure a certain profit. If such methods were clung to tenaciously and too long, and the competition of modern operation and high efficiency was encountered, a process of reorganisation, liquidation, or reconstruction threatened. Those who faced the situation thoroughly and in good time, managed to revitalise their concerns by the adoption of new principles, new equipment, and systematic observation and control of manufacturing costs—in short, by ensuring that Capital, Labour, management, and equipment were all so employed as to secure the maximum of efficiency at the minimum of cost and with the minimum of friction. Individual manufacturers naturally arrived at different results—there could not be uniformity in geographical conditions, purchase, or selling conditions; many, and sometimes all, of the contributing factors differed. In open competition tenderers were able to see something of each other's ability, and each strove, in the absence of "understanding" between them, to secure a piece of business, perhaps undercutting or accusing somebody else of doing so, and wondering how on earth such production results could be arrived at. Each manufacturer got to know a little about the inner operations of the other's offices and works—perhaps by fair means, perhaps by subterfuge, to use a euphonious term. But there was always the incentive remaining to strive after higher efficiency, to secure improved results, by some means or other. Every manufacturer guarded his own purchasing, operative, and production data, as secrets to be preserved inviolate from the curious eyes of others engaged in the same section of industry. In this he was doing little more than the ordinary man of trade. The custodian of capital, whether his own, his relatives', or his shareholders', he had to safeguard that capital, and to ensure a return upon it, and if in the progress of manufacturing or trading special experience had been purchased which could not be gained in any other way,

that was the peculiar property of his concern, which could not be divulged to anybody but those who were interested in making that business a success. We may criticise this attitude when we try to take the wider view of things that must characterise our study of national industry as a whole, but we must recognise that along such a course lay the path to individual efficiency and success. To-day, when we are faced with problems of future production involving mutual understandings which amount to combinations, amalgamations, or co-ordination of interests, we may not be so enamoured of the policy of individual action, because we anticipate that a large number of isolated concerns cannot hold up against the combined assaults of scheming Continental industrial organisations or trusts which possess all the advantages of consolidated effort. Yet, however far we may carry the idea of combination of interests, the fact still remains that the efficiency, enterprise, and initiative of the individual unit will be as necessary as, or more necessary than, they ever were in the past.

One of the secrets of success in the combined organisation of the future will be the safe utilisation of all these isolated cases of individual efficiency for the best interests of national industry as a whole, without unnecessarily damaging the value of any of the concerns. Everybody, we think, sees the necessity for the great and strong combination—we hope for gratifying results to accrue, in due course, from some of those already established during the war. But nobody supposes that engineering industries are going to fall into a few settled groups and everybody else will go to the wall—that would be a sheer absurdity. The "small manufacturer" (what capital or turnover do we imply by that expression in these days?) will always fill a considerable place in British, American, and Teutonic industry, and the life and energy of some of them in their operations to-day show that they intend to do so.

Notwithstanding all this, however, there are changes coming over industry as a result of the ownership of numerous war-time factories by the Government, and as the outcome of Government control of thousands of other works in and out of the electrical industry under the Munitions of War Acts. The possession of secrets concerning manufacturing costs in individual factories, to which we have referred above, has been materially affected. Whereas, in the old days, such data were the exclusive property of the holder, they are not so to-day, for though manufacturers themselves do not indulge in an exchange, there is a mass of material in the hands of the Ministry of Munitions and of the Dilution Branch of the Ministry of National Service which may be of wide-spreading effect in the establishment of standards for labour, cost, &c. It is not conceivable that material of such a kind, and on such a scale, would ever have been brought together by British manufacturers acting voluntarily. Only under war conditions and under State operation could it be possible. The subject has been alluded to in several technical engineering journals recently, in connection with a valuable paper which was read before the Institution of Mechanical Engineers early in May by Mr. B. H. Morgan, who for two years was Technical Adviser to the Labour Supply Department of the Ministry of Munitions, and who to-day is in charge of another Department, where the material accumulated will be of inestimable value in assisting the manufacturers to attain to high standards of efficiency of labour employment and of production at a time when the military call upon their labour is becoming more pressing than during the whole period of the war. The paper is entitled "The Efficient Utilisation of Labour in Engineering Factories—with Special Reference to Women's Work," and the discussion that has taken place upon the subject shows that the engineering world is alive to its importance not only because of the emergency of the moment and the need for us to adapt ourselves to all that it involves in the way of dilution, but also on account of the after-war effect which the tabulation of labour and production data in industry on a large scale is likely to exercise upon our whole manufacturing position, assuming that the data collected and the standards evolved under conditions governing war-time production can be applied in some manner to private industrial operations. We hope to return to the subject in further detail.

Industrial Problems.

On two occasions this year, Mr. F. S. Button, of the Committee on Production, has contributed to a discussion at the Engineers' Club, Manchester, on the subject of Whitley Committees. The remarks made by him at the resumed discussion in March have been printed in pamphlet form, and copies can be obtained (4d.) from the Hon. Secretary of the Club, Mr. H. Richardson, Albert Square, Manchester. It is not unusual for speakers who endeavour to popularise the Whitley idea to be criticised for vagueness or want of definiteness as to the manner of applying the principles to a particular trade. Mr. Button apparently shared this experience, and so in March he returned, by invitation, to elaborate his ideas for applying the Whitley proposals stage by stage. His synopsis includes the setting up of four separate, yet interdependent, bodies:—The Works Committee; the Central Works Council; the Local District Council; and the National Industrial Council. The matter is, in our estimation, one of extreme importance, and we hope that those who are taking a real interest in the question and its bearing on our particular industries will secure a copy of the pamphlet. In some supplementary observations on the subject of arbitration, Mr. Button said that if Capital and Labour gave the Whitley scheme a fair trial, greater productivity in the workshop must inevitably result. He thought it might well be that a more scientific method of adjusting wages to output might be evolved, and as the problem of production was solved, so the problems and methods relating to distribution might equally have brain power plus humanising agencies applied to them. Mr. Button suggested that the old-fashioned machine of the lock-out and the strike on wages questions be scrapped, and periodical revisions by methods of arbitration take their place. He predicted that in the future the settlement of wages questions would be affected by such considerations as the variations in the cost of living, increased output, market prices for the article produced, the state of trade, and gold values. Employers and employed may not agree to any form of arbitration on technical questions requiring great knowledge and experience of the trade concerned, yet we are faced with the prospect that in future industrial conflicts will rage largely for the control of industry itself. During the past month or two voices have not been so insistent in demands to that end, probably because the German offensives have overshadowed everything else, but the demand will come later with full force, and in preparation for the coming years we should be taking measures for "granting a real constitution to every industry"—"a constitution which will enable Capital and Labour to reach, on a mutual basis, the points on which their interests harmonise, and then to extend the system until the parties coalesce." Only by such action, taken in good time, can we, in the opinion of Mr. Button, prevent "Armageddon."

Mr. G. H. Roberts, Minister of Labour, in one of his latest utterances has shown that he is under no delusion respecting the troublesome times that will follow the war. He was alluding, we believe, more particularly to troubles outside these islands and in connection with trade. Such considerations only lend emphasis to the appeal for friendly relations between all industrial parties at home; but no appeals will avail unless we take definite preparatory action.

Attention may profitably be directed to an article appearing in the *Board of Trade Journal* for June 6th relating to the provisions of the Chambers of Labour Bill, a Government measure which is now receiving attention in the Reichstag. The writer makes a comparison between the proposed Chambers and the Works Committees which have existed in Germany for many years. It appears that until December, 1916, there was no obligation of any kind to establish a Works Committee in any industrial concern, but at that date it was made compulsory in all such concerns engaged in work of national importance, and in which 50 or more workpeople were employed, for Works Committees to be constituted and permanently maintained. These Committees are intended to promote harmony amongst the workers themselves and between them and the management, and the Committee has to bring before the management the "proposals, wishes, and grievances of the

workers relative to the conduct of the concern, to the wages and other labour conditions, and to the general welfare of the business," and to express its opinion thereon. The direct and secret ballot are employed, based on principles of proportional representation from the workpeople, and similar provision is also made in respect of the salaried staffs. The *Journal* sets forth the full details of the Chambers of Labour Bill proposals, the functions, composition, constitution of the Chamber, &c. It is not pretended that the Works Committees referred to meet the needs of Labour; no meeting, save of a preliminary kind, can be held unless under the chairmanship of the employer or his representative, and he conducts the discussions.

The promotion of healthy relations between masters and men—in other words, "fostering industrial harmony"—the initiation of measures to improve the position of the workers, "especially of the rising generation," co-operation in collective labour agreements, to establish employment exchanges, and to co-operate in finding employment for wounded and invalid soldiers, and for others out of employment owing to the war—these are some of the special functions of the proposed Chambers. The Bill has been subjected to a good deal of criticism, especially from the *Vorwärts*, as reference to the *Journal* will show. We have given so much attention to after-the-war Labour conditions in this country, and the preparations that should be made for that period, that it is unlikely that we can learn anything from Germany which will be reproducible in the very different conditions that prevail, or may prevail, here. But we are sure that those interested in the subject will not consider wasted any time devoted to a study of the German proposals.

Cui Bono?

It might have been supposed that some of the experiences of the past four years would have had a restraining influence upon some energetic spirits who are eager to throw stones or to stir up mud. Several prosecutions in the Courts have demonstrated that not all minds are as well balanced as they might be; let us charitably attribute the malady to long-continued war strain. We prefer to credit men with higher motives than their actions suggest, though the old Scriptural quotation about knowing men "by their fruits" is a fairly safe guide as a rule. It is unfortunate that even to-day there are amongst us men who are not unwilling to employ some of the loftiest of a people's aspirations and the most high-sounding phrases in the interests of noisy propaganda. We may have a laudable contempt for the man whose musical tastes can only be gratified by the beating on a big drum, or for the tub-thumper whose oratory at the street corner merely shocks our presumptions to refinement. Wearing their shibboleths inscribed upon their swelling breasts, perhaps in mocking semblance of Pharisaic phylactery, they boost their own reputations by thanking the Lord that they are not as other men are. When we recall that it is written of such that "they have their reward," there is something within us which whispers curiously inquiring what the exact nature of that reward may be. What are the ends that they have to serve by casting reflections haphazard upon others whose convictions are quite as sound as their own, though their emotions and their vituperation may find expression with greater calmness and good judgment? Perhaps it is a thing for which to be profoundly grateful that all men are not cast in the same mould. Perhaps, too, it would be better if we recognised that such variety is as unalterable as the laws of the Medes and Persians; then we might find other ways of attaining the best ends. For ourselves, we prefer the man who, if he has something to say, will deliver himself openly. But there are those who prefer to spread their thoughts by means of insinuation in secret conclave assembled, or in converse on the lone byeway, where those they seek to malign will be out of ear-shot. The best interests in any cause will never be permanently secured by means of such devices.

It is not always what others "have done"—sometimes it is what they are *said* to have "left undone"—that induces the insinuator to suggest that there is "no health" in the object of their attack. It is so easy to know another man's business better than you know your own!

Surely, if the heart of the British nation is sound, and that of British industry beats true, we can afford to deport ourselves more worthily and with greater dignity along a higher plane. If ever there was a time when the clarion call was in the ears of all to close our ranks, to cast out petty suspicions, to abandon the slavish pursuit of personal interests, "taking a rise" out of everybody else, and face in unity the coming of new conditions which will require the best from all of us, that time is now!

Electrical Engineers' Associations.

Last week we were able to report progress towards the formation of the Electricity Supply Section of the Association of British Electrical Engineers, which was unanimously supported by the Newcastle Local Section of the I.E.E. at a "mass meeting" of those interested in that neighbourhood. In the same issue we gave particulars of the comprehensive objects of association of the Electrical Power Engineers' Association, which will commend themselves to all who are eligible for membership, and which certainly constitute an ambitious programme. It will be noted that Mr. Wordingham is in communication with the promoters of the E.P.E.A., with a view to arriving at an understanding between the two bodies, a matter of the first importance. A letter in our "Correspondence" columns to-day indicates that the E.P.E.A. claims to cover the same ground as the embryo Association, and the position is full of difficulty, which will tax the ingenuity of the President of the Institution to surmount. Our hope is that a satisfactory solution to the problem will be found, for the continued existence of two organisations with similar objects and cultivating identical fields would represent a deplorable miscarriage of the principle of co-operation by which we must be guided in all our undertakings.

We publish elsewhere in this issue particulars of the new movement inaugurated by the British Engineers' Association, which already includes in its Section "A" manufacturing firms, in Section "B" allied concerns, and now is forming Section "C" to consist of individual engineers and others connected with engineering. This new Section also comes into existence with influential support, as would be expected from its parentage, evidently having the approval of the three great engineering institutions. The objects of the section are set forth in our "Notes," and are in every way praiseworthy. In this connection we may draw attention also to the "Manufacturers' Section" of the Association of British Electrical Engineers, foreshadowed when the "Electricity Supply Section" was set on foot, and now, we believe, in process of formation. The purpose of this Section, like that of the "Electricity Supply Section," is to provide the members—technical men in the manufacturing electrical industry—with a strong Association for the purpose of collective representation in matters concerning their welfare; its proposed organisation is also on similar lines, and it will be registered as a Trade Union in order to secure the necessary legal status, though, of course, its policy will be defined on unobjectionable lines.

Every one of these significant movements deserves our heartiest support, though their number is somewhat bewildering and their objects are apt to overlap; for instance, the whole of the members of the "Manufacturers' Section" of the A.B.E.E. would doubtless be eligible for membership of the "C" Section of the B.E.A., but the converse would not hold good. Our readers may be expected to enter a protest against the multiplication of alphabetical conundrums with which they are confronted every week, and our only excuses are that it is not our fault, and that space is precious. But does it not appear that some collective action should be taken to co-ordinate the efforts that are being made to organise these new Associations? There is a real danger that they will be weakened by their very multiplicity if the process of creation of new Associations is permitted to go on uncontrolled much longer.

COMPUTING THE SPEED OF RECEIVING A TELEGRAPHIC MESSAGE THROUGH SUBMARINE CABLES.

A UNIVERSAL METHOD.

BY J. RYMER-JONES.

IN a pamphlet published by the ELECTRICAL REVIEW office in December, 1911, the writer explained a method having the above object, the novel and important characteristic of which is that of *counting* all the elements which constitute the letters, or numerals, occurring in the part of the received message dealt with, instead of giving to all letters the same mean number of elements (e) based on 1,000 or more words found in newspaper paragraphs, as has hitherto been a common practice; but which has not even the recommendation of applying *equally*—albeit incorrectly—to very short or long messages, code words, groups of numerals, or foreign languages.

Owing, however, to the writer having dealt rather widely with the subject in the above-mentioned pamphlet—by including a comparison between the International and U.S. of America Morse alphabets—their mean elements per letter (e), or per word of 5, 7, or 10 letters, their relative speeds, the recurrence per cent. of all the letters in the alphabet in the case of different kinds of messages, a table of *constants* for reducing e.p.m. to w.p.m., and other considerations bearing on the subject—the speed method itself has, it would seem, in some measure been eclipsed, and made to appear rather formidable, whereas it is really very simple, and quickly effected with the assistance of Form A.

From letters received the writer is glad to know that the principle of *counting the elements* in the letters of the part of the message dealt with has been appreciated by several interested in finding a more satisfactory and common basis for comparisons than adopting an assumed average number of elements (e) per letter, as referred to above.

One correspondent writes: "I have just been re-reading your brochure on 'Method of Computing Speed of a Telegraphic Message.' This is very valuable, as, so far as I know, it is the only published 'count' of signalling elements in existence."

It has been suggested that a shorter statement dealing only with the method itself would make its simplicity and advantages more obvious.

This the writer would preface with the remarks that its simplicity is due to the fact that *in principle* only *one word* is sufficient from which to evaluate the speed, though in practice it is better to select five or six words (see example in Form A); and that not only does the method apply to automatic sending, but it has another and special value for hand-transmission, because it puts the latter system on the same satisfactory basis in this respect as the former, since it makes the calculated result independent of *unequal* spaces, due to hesitations or "rub-outs," by making a proper allowance in the formula for the recognised number of space-elements between words.

Specimen Signals.—As the characteristics of long cable signals differ greatly, and as the number of elements, or words, receivable per minute must depend to some extent on the expertness of the receiving operator, it is generally understood that the standard of legibility to be maintained is such that the definition of signals at the rate reported for the speed-trial should not be misread by any of the ordinarily qualified clerks, who are familiar with that particular circuit, during a reasonably long stretch.

On this account, therefore, affixing specimens of signals to the daily returns of speed-trials furnishes the best criterion of their relative quality; to what extent the level of excellence is being maintained in the adjustments; and evidence that the speed reported is not to be attributed to the special expertness of the clerk in deciphering difficult signals; but that they are fully up to the specimen preserved as a standard for comparisons.

Elements per Minute (e.p.m.).—This basis is itself a perfectly satisfactory standard of comparison, applicable to all kinds of telegraphic messages, in all countries employing the siphon recorder or Morse recorder, because expressed in terms of the same definite and universally understood unit, viz., the *element*.

It is only when the *elements per minute* are reduced to l.p.m. or w.p.m., that uncertainty and confusion often arises as to the precise value of the *letter or word*. In order to prevent a *definite* being converted into an *indefinite* value, what is wanted is either to state the e.p.w. employed, or to adopt a generally-agreed-to number of elements per *standard letter*, or per *standard word* of n letters, including a proportionate allowance for space-elements between letters and words; then—*provided that the actual elements constituting the selected part of the message be counted*, as shown in Form A—this adopted *constant* in elements per letter, or per word, will enable anyone to correctly convert speeds expressed in l.p.m., or w.p.m.. into elements per minute; which, as already stated, has only one meaning, whether the message be short or long; code words or groups of numerals; in English or any other language.

E.g., in the formula for speed in w.p.m., the *numerator* $N = E/T = [L\,e + s(L - W)]/T$ = elements per minute; *i.e.*, the total elements in the letters of the words selected for a speed-trial, together with a proper allowance of space-elements between letters and words, divided by the time (T minutes) during which it was recorded.

The denominator (D) expresses the elements per standard word of n letters, also including the proportionate allowance for spacing between letters and words—*i.e.*, $D = e \times n + 3(n - 1) + 7(W - 1)/W$ elements.

The number (n) of letters per word is generally stated, but the uncertain quantity in the denominator (D) is the value (e) elements adopted per letter.

Moreover, the expression $7(W - 1)/W = 7$, provided that the part of the message dealt with consists of *many* words; but if it consists of only six words, as in the example given in Form A, then the number of words (W) and of letters (n) per word are required in the denominator, as well as the questionable number of elements for e. These two possibilities of error, but more especially the value of e, account for the uncertainty often attaching to speeds merely expressed in words (of so many letters) per minute without stating also the particular number of *elements per word*.

The principle of counting the actual elements constituting the letters of a few selected words in the message; calculating (in the manner described in Form A) the time of receiving those words; and computing from these two data the speed of recording the message in e.p.m., is equally suitable for very short or long messages; for short or long code words; for numerals; and also for messages in any foreign language capable of being transmitted in the International, or U.S. of America, Morse alphabet, and received on the Morse instrument or siphon recorder. Moreover, if the absolutely definite *element* is adopted as the basic unit in which to express speed of signalling through all cables, it may fairly be claimed that this method is capable of *universal application* to all submarine cables.

The relative working of the same cable from day to day is conveniently expressed in e.p.m., while the speed-rate *onstant* * when expressed as KR × e.p.m. should correctly express not only the efficiency of that cable, but its efficiency as compared with that of any other cable whose KR × e.p.m. are known.

Therefore, if plotted daily on a curve sheet, the speed-rate *constant* will correctly indicate at a glance the effective working—*i.e.*, to what extent any cable is daily realising the rate of output which its KR permits of when compared with the best-recorded performance of any other long cable, worked under the same conditions.

Re Elements per Letter and Constants.—A considerable error may enter into the numerator of the old speed formula on account of the number of elements (e), adopted as representing an average letter for the whole message, really varying greatly in different kinds of messages. This source of error is entirely eliminated by employing the method recommended by the writer—*i.e.*, *counting the actual elements in all the letters (or numerals) which occur in the message*; adding a proper number of elements for spaces between

* Expressed by Dr. Muirhead as the KR × speed in w.p.m. See "Speed Standards and Circuit Efficiency," by Edward Raymond-Barker. Munro and Jamieson's Pocket-Book Edit. 19, p. 350.

letters and words, and reducing these elements to elements per minute. If this be done, then any error which arises when reducing elements per minute to letters, or words, per minute will be entirely due to the *constant* (*i.e.*, denominator of the formula) not being suitable.

The writer has given later on some *constants* for reducing

FORM A.*—DATA REQUIRED FOR CALCULATING THE SPEED OF A MESSAGE.

Number of Letters and Numerals = 41 (L) Words = 6 (W) Date:.....

Message. " Speed of telegraphing through submarine cables "

$$\text{Speed of working} = \frac{E}{Lo + s(L-W)} \over T = \frac{\text{Elements received per minute}}{\text{Elements per standard word including space elements between words } (Ew_2)} = \text{standard w.p.m.† of } Ew_2 \text{ elements}$$

$$\text{Columns in Table I} \quad \frac{179 + 3(41-6)}{0{\cdot}2864} \over \frac{}{32{\cdot}18 + 7\frac{6-1}{6}}$$

$$= \frac{991{\cdot}5}{39{\cdot}18} = 25{\cdot}3 \text{ Standard w.p.m. of } 39{\cdot}18 \text{ elements.}$$

Space (longer‡) in spaced letters.
" (s) between letters of words.
" (s_1) " words.
Value of ordinary "dash."
" letter L.

Counting elements.

For every letter or numeral as it occurs in the selected part of the message make a stroke on the line corresponding to the same printed letter (or number) in Form A

The elements composing the letters (or numerals) are, for the Syphon Recorder, as given in Col: A.

Multiply the number of similar letters (or numerals) in Col: L by their respective elements per letter (or numeral) given in Col: A.

Timing message:-

The Operator at the Recorder marks the running tape at 2 points (say) 10 seconds apart. This is to be measured * when convenient after Lt.

Mark the extreme limits of each of the 6 selected words separately. Measure the exact length of each word with the same scale *

Add all 6, measurements to get Lw - viz: the length in a continuous line without any spaces between words

Measured lengths of 6 words: 40·8 m/m, 10·7 ", 106·5 ", 69·7 ", 77·6 ", 39·2 "

Lw = 373·5 "

* A short length of perforated tape folded in a line with its length provides a suitable scale as only relative measurements are required to give time (T)

		Letters & numerals L	Elements L x A	Number of elements. International code. Syphon recorder A	Morse recorder or sounder. B	C	D	E	F	U.S. of America and Dominion of Canada. Morse recorder or sounder. G	H	I	J	K	L
				—	—	—	—	—	—	3	2	2	2	2	2
				3	3	3	3	2	2	5	5	5	3	5	3
				7	7	5	5	5	3	7	7	7	5	7	5
				1	3	3	2	2	2	3	2	3	3	2	2
				—	—	—	—	—	—	5	3	5	5	3	3
				A.											
A	a	3	9	3	5	5	4	4	4	5	4	5	5	4	4
—	ä			7	11	11	9	9	9	—	—	—	—	—	—
B	b	2	14	7	9	9	8	8	8	9	8	9	9	8	8
C	c	1	7	7	11	11	9	9	9	7	7	6	6	6	6
D	d	1	5	5	7	7	6	6	6	7	6	7	7	6	6
E	e	6	6	1	1	1	1	1	1	1	1	1	1	1	1
—	é			11	11	11	10	10	10	—	—	—	—	—	—
F	f	1	7	7	9	9	8	8	8	7	6	7	7	6	6
G	g	3	15	5	9	9	7	7	7	9	7	7	9	7	7
H	h	3	21	7	7	7	7	7	7	7	7	7	7	7	7
I	i	2	6	3	3	3	3	3	3	3	3	3	3	3	3
J	j			7	13	13	10	10	10	11	9	11	11	9	9
K	k			5	9	9	7	7	7	9	7	9	9	7	7
L	l	2	14	7	9	9	8	8	8	5	3	5	5	3	3
M	m	1	3	3	7	7	5	5	5	7	5	7	7	5	5
N	n	2	6	3	5	5	4	4	4	5	4	5	5	4	4
	ñ			9	17	17	13	13	13	—	—	—	—	—	—
O	o	2	10	5	11	11	8	8	8	5	5	4	4	4	4
	ö			7	13	13	10	10	10	—	—	—	—	—	—
P	p	2	14	7	11	11	9	9	9	9	9	9	9	9	9
Q	q			7	13	13	10	10	10	9	8	9	9	8	8
R	r	3	15	5	7	7	6	6	6	7	7	6	6	6	6
S	s	3	15	5	5	5	5	5	5	5	5	5	5	5	5
T	t	2	2	1	3	3	2	2	2	3	2	3	3	2	2
U	u	2	10	5	7	7	6	6	6	7	6	7	7	6	6
	ü			7	11	11	9	9	9	—	—	—	—	—	—
V	v			7	9	9	8	8	8	9	8	9	9	8	8
W	w			5	9	9	7	7	7	9	7	9	9	7	7
X	x			7	11	11	9	9	9	9	8	9	9	8	8
Y	y			7	13	13	10	10	10	9	9	8	8	8	8
Z	z			7	11	11	9	9	9	9	9	8	8	8	8
	1			9	17	17	13	13	13	11	9	11	11	9	9
	2			9	15	15	12	12	12	11	10	11	11	10	10
	3			9	13	13	11	11	11	11	10	11	11	10	10
	4			9	11	11	10	10	10	11	10	11	11	10	10
	5			9	9	9	9	9	9	11	8	11	11	8	8
	6			9	11	11	10	10	10	11	11	11	11	11	11
	7			9	13	13	11	11	11	11	9	11	11	9	9
	8			9	15	15	12	12	12	11	10	11	11	10	10
	9			9	17	17	13	13	13	11	9	11	11	9	9
	0			9	19	19	14	14	14	7	5	7	7	5	5

‡ Constant (Ew_1) for 5 letter words p.m. = 32·18 approx: Totals = 41 . 179 = Le.
Sum of words = 6

Space elements between all letters but not between words and sentences = s (L − W) = 3 × 35 = 105

Elements in selected words including spaces between letters but not between words Le + s (L − W) = 284 = E.
Length of paper tape between the limits of the above words measured in scale divisions = 373·5 " = Lw — ~~see Slips 6 and 16.~~
" " running during t seconds preceding message = = 217·3 " = Lt — ~~See Slips 4 and 12-15~~
" " " t " after " " =
" " " 60 " = $60\frac{Lt}{t}$ " = $\frac{60 \times 217{\cdot}3}{10}$ = 1303·8 " = Lm.

Time of receiving the above words in an unbroken line of E Elements = $\frac{Lw}{Lm} = \frac{373{\cdot}5}{1303{\cdot}8} 0{\cdot}2864$ = T minutes = 17·186

Number of elements received per minute = $\frac{E}{T} = \frac{284}{0{\cdot}2864} = 991{\cdot}5 = \frac{Le + s(L-W)}{T}$ = e.p.m. [See Speed formula on this Form.]

t = 10 seconds. Speed-rate constant = KR x 991·5

Specimen of Signals and General Remarks.

Trial speed. If the same words be sent the daily trial-speed is very quickly made because the elements in these words (284) when properly spaced, are known so that it is only necessary to measure the time (T) in minutes — see timing message — and apply it to the very simple formula viz Speed of working = $\frac{284}{T}$ e.p.m. or 7·249 standard w.p.m. of 39·18 elements.

The time occupied at the Recorder is T the 10 seconds for timing the tape and a few seconds more for cutting off the 6 specimen words. The results can be entered in Form A by anyone when convenient.

* Books of 24 Printed Forms A, Price 1s. per Book, can be obtained at The Electrical Review Office, 4, Ludgate Hill, London, E.C.

the number of elements per minute into *approximately* the equivalent average (English) words (newspaper or code) of 5, 7, or 10 letters respectively. The elements in these so-called *constants* are supposed to represent n times the average elements per letter in a large number of such n letter words—plus a due allowance for space elements between letters and words; but neither these nor any assumed number of elements for the alternative *standard* words are equally applicable to very short and long messages, to newspaper phraseology, to short and long code words, or to foreign languages. This is, however, a difficulty easily surmounted by the simple expedient of stating the speed in w.p.m., *together with the constant employed*, in order to denominate exactly the divisor used to give those w.p.m. If this be done, then the speed so obtained will still have a very definite meaning for the same cable as an index as to its daily efficiency. Moreover, whatever any cable company may for its own convenience think fit to allot to (e); whatever letters (n) to the *word*; or whatever the number of words (w) dealt with, these need not concern anyone else, because he can by means of the *constant* supplied to him correctly convert telegraphic speed expressed in w.p.m. into elements per minute—*e.g.*, either as a basis for calculating the KR, or the weights of conductor and dielectric per unit length, required for any projected cable, in order to give a specified speed of equally legible signals—if worked under the same conditions.

The suggestion is that instead of the speed being *indefinitely* expressed as (w) words, of n letters, per minute, it be given as (w) „ (constant) elements, „ „ which will be a very definite statement and universally understood.

In the pamphlet already referred to the following *constants* are given :—

	Words.	Letters.	e.p.l. (e)	Constants $E w_1$	Constants $E w_2$
For 5-letter words, news paragraphs	1,200	5,670	4·036	32·18	39·18
7 „ „	„	„	„	46·25	53·25
10 „ „	„	„	„	67·36	74·36
For 5-letter words (code words) ...	1,230	6,150	4·377	33·88	40·88
7 „ „	1,256	8,792	4·226	47·58	54·58
10 „ „	883	8,330	4·139	68·39	75·39

If for siphon recorder, $E w_2$ be taken as 40 elements per word of 5 letters, and for Morse recorder $E w_2$ be taken as 50 elements per word of 5 letters, } International alphabet.

the speed in w.p.m. would thereby be standardised and rendered universally comparable.

Elements per Minute.—According to the usual practice, the elements per minute may be supplied by the *sending* station, because the number of elements during any particular minute equals twice the number of centre holes in the perforated paper passing through the automatic transmitter *during that minute*; or, alternatively, the revolutions per minute of the transmitter friction wheel multiplied by twice the number of periphery interstices working against the star wheel (†).

On the other hand, by the writer's method, the *receiving operator* has the advantage of being able to judge the quality of signals at any time; and as often as he likes he can mark the slip running, during 10 seconds, without necessitating the delay of having to make arrangements with the sending station, or troubling the operator to time and measure a very much longer length of perforated tape. Moreover, the *receiving* operator marks the slip running during 10 seconds *while the actual words selected for the speed trial are being recorded.* This is all that the operator at the instrument need do, because the slip passes along to be cut off, measured, and the results entered in Form A by some one else at their leisure.

A.C. Sounders on Fire Alarm Circuits.—Mr. H. A. Bowen, superintendent of fire-alarm system, Cleveland, Ohio, has recently installed a number of Ghegan alternating-current sounders as local signals in fire stations. They are connected directly with the A.C. lighting system, thus doing away with a large number of dry batteries which were formerly required. These A.C. sounders fulfil all requirements, and it is proposed to equip the entire 45 engine houses with them as fast as the installations can be made.

† *Cf.* "Speed Standards and Circuit Efficiency," by Edward Raymond-Barker, in Munro and Jamieson's Pocket-Book, 19th Edit., p. 349.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Patent Licences and European Reconstruction.

When the war comes to an end a vast field will be opened in the Allied and Neutral States on the Continent and in Siberia for the supply of power generating plant, and, to a lesser extent, for traction apparatus.

A number of our leading engineering firms will wake up to find their hands tied, and their good prospective markets barred, because they have acted as licensees for patents the continental rights of which have been developed by or assigned to continental interests, and agreements have been signed forbidding export to various countries.

At one time British engineers were pioneers, and were willing to develop and experiment on their own account, but in recent years, especially in connection with steam turbines, fuel oil engines, and power-house plant, they have been prone to putting their heads into nooses, the other ends of the ropes being only too often in the hands of Germans, or of those in neutral countries who are not in a position to resist the German pressure resulting from international finance or questions regarding raw materials for manufacture.

Parliament originally intended patents to last 14 years only, but the taking out of periodical improved patents together with ingeniously worded licence agreements, and the natural tendency of clients to buy plant with well-advertised names attached, have tended to turn a number of patents almost into perpetuities.

On the continent, before the war, despite numerous amusing disclaimers, traction and power-house machinery makers were often closely allied, competition being in general more apparent than real; the influence of the Berlin-Frankfort financial octopus was found in many unexpected quarters, and genuinely independent British firms who attempted to obtain work, even in the neutral outer fringe, found very powerful underground interests opposing them, interests as often as not which had been developed through the peaceful penetration of sympathetic British subjects in London.

In modern days the practical validity of master or other patents depends much more on the financial standing of their owners than on the nature of their subject matter, and sometimes through collusive actions or pure bluff, firms who fear law cases with powerful interests give way, and pay unearned tribute to avoid continuous worry, if not possible ruin, through piled-up law costs or boycotting.

In the past we have suffered severely through international wire-pulling over master patents which our disunited manufacturers have been unwilling to fight; these include three-phase plant, single-phase traction, the fuel-oil engine, the metallic lamp, and various systems of steam turbines. Development has been retarded, and valuable markets practically shut out. One feature of many of those master patents which have been in the hands of so-called "British subjects" has been the fact that, while British firms have not been allowed or encouraged to do business in various continental countries, the continental firms, or their hand-in-glove allies, have been assisted by many in the exploitation of our home and colonial markets.

It would be interesting to know how many "sons or grandsons of Huns" who were disappointed over the non-delivery of German patented goods or machinery will find opportunity after the war of making good the losses of their former confidants with compound interest by further agreements and sympathetic wire-pulling. Many thousands of pounds have been paid in recent years to foreign and other syndicates as licence fees for the almost worthless patents and so-called "experience." The cost of local development or redesigning to suit markets is often overlooked when agreements are made, and it must not be forgotten that to some international syndicates the markets control clauses are worth as much, or even more, than the licence fees, as witness the existence before the war of some companies in England in a state of dividendless bliss, merely to keep undesired independent manufacturers in a state of impotence with regard to certain classes of work in the world's trade.

Those who want to take up a new class of work may find it very nice to buy designs ready made, for a nominal payment or percentage, but contracts for licences should be carefully studied, and unfair, one-sided barring clauses resisted to the utmost, otherwise manufacturers may find they have purchased an almost worthless roll of drawings at the cost of their future in the markets of the world.

Monitor.

A Question of Competition.

It is all too seldom—as I feel sure your numerous contractor readers will agree—that a subject relating especially to electrical contractors is ventilated in your columns; hence my reason for asking your permission to refer to two matters mentioned in your issue of May 31st.

The letter from Messrs. Watson, Marsh & Co. discloses a deplorable state of affairs, and it is to be hoped that, although such cases do undoubtedly exist, they are the exception rather

than the rule. As a contractor with branches in several towns where the supply authorities range from a private company with a fully-equipped contracting business to a Corporation with no trading powers, I am happy to say I have not come across a supply authority stooping to such tactics as those quoted by Messrs. Watson, Marsh & Co. in their second case. In fact, I have on several occasions received real help from supply companies, even where they are in open business as contractors. I would suggest in cases such as your correspondents mention that, if these are beyond the scope of the Contractors' Association (which, as a new member of that body, I am sorry to hear) a small committee of local contractors should carefully examine the circumstances of each such case, with a view to legal action wherever possible, for surely the procedure mentioned by Messrs. Watson, Marsh & Co. comes perilously near what the lawyers call "misrepresentation."

The other point on which I wish briefly to touch is the Manchester address of the President of the I.E.E. reported in your paper. This is a most interesting general review, but although considerable attention is given to the generating and manufacturing sides, I cannot find the slightest mention of the contractor—or, as he should be called, the electrical installation engineer—though neither generating nor manufacturing would go far without him. Incidentally, this may throw some light on the President's complaint about members "putting away the *Journal* without opening the covers." On many occasions I find that the list of contents *outside* the cover is quite sufficient to justify me—as, I hope, a not narrow-minded contractor—in stopping at the covers. The one bright spot in the I.E.E., from the point of view of the contractor member—the Wiring Rules—becomes the more brilliant from its splendid isolation.

E. Arthur Pinto, A.M.I.E.E.

Ramsgate, *June 3rd*, 1918.

The Electric Propulsion of Ships.

On page 455 of your paper of May 10th, under the heading of "The Electric Propulsion of Ships," you give a summary of a paper read recently by Mr. Eskil Berg describing the electrical installation of the U.S. Battleship *New Mexico*.

Some comparisons are given with other kinds of installations as regards economy. It is necessary, I think, to call attention to a significant error in the presentation of these comparisons. The battleships *Florida* and *Utah* are not, as the writer states, equipped with geared turbines, but with turbines directly connected to the propeller shafts, the speed of which is consequently high. These vessels were equipped with turbines of the Parsons type in 1908, and, whilst they are still doing excellent service, the steam consumptions bear no comparison with the results which can be obtained at the present time, adopting the many improvements that have been made during the last 10 years. The writer states that he gives these comparisons "in order to be able correctly to judge the relative economy of different methods of propulsion"; but to compare the results which it is estimated will be obtained in a new vessel with results that were obtained 10 years ago, whilst ignoring the enormous developments which have taken place during that period, apart from the inaccuracy referred to above, is hardly conducive to such a judgment.

The steam consumption at 19 knots is given as 11.1 lb. per shaft horse-power, whilst the water rate per effective horse is estimated to be 15.0 lb. per hour at this speed. This corresponds to an estimated propeller efficiency of 74 per cent., a very sanguine assumption for a battleship propeller. There is, however, no need to mix assumptions and confuse the issue in this manner. Since with mechanical gearing equally low revolutions can be adopted if desired as with electrical gearing, the propeller efficiency may be taken the same in either case. Whatever turbine efficiency can be obtained with one system can be obtained with the other. There only remain the losses of transmission, the comparison of which is about 10 per cent. in favour of mechanical gearing.

The ingenious manner in which the writer of the paper has converted this obvious inferiority of 10 per cent. into an apparent advantage of between 40 and 50 per cent. is likely to be misleading to your readers, and calls for prompt correction.

Stanley S. Cook.

Wallsend-on-Tyne, *June 4th*, 1918.

A British Ideal for Manufacturers.

"Imperial's" article in your issue of May 31st will be welcomed by many who are seriously concerned about the future of our industry.

The war has shown us that the engineering industry is of the most vital national importance. Is it not possible to have it British? If not, then let us at least know where we are, and with whom we are dealing.

Mr. Wordingham suggested a remedy in his presidential address in these burning words: "Let the first question asked when dealing with a firm be 'Is it British,' and if it be not, then let one be sought that is." They ought to be branded on the memory of every buyer of engineering plant in this Empire of ours. The trouble is to know who is who.

The term "British" as applied to the name of a firm often implied that it was alien. Is it not time that the law was altered to ensure that the word and all that it means to us should not be prostituted in this way; that some distinction in title was made in firms which are wholly British to the core (shareholding, directorate, and policy), so that they may be distinguished at a glance, without reference to Somerset House, from those which are not?

If this were done, and Mr. Wordingham's advice were followed, we should need no tariffs or other protective measures at all.

There is, as "Imperial" suggests, a great scope for a combined effort of all interested in the future welfare of our industry to secure what he terms "a sound basis at home."

Briton.

Government Lighting Restrictions and Saving Coal.

In connection with the new lighting restrictions of the Government (Heating, Lighting, and Power Order), I quote the following from an interesting circular issued by the United States Government Bureau of Standards, Washington:—

"The tungsten lamp has been improved in quality and reduced in price to such an extent that no customer can afford to use carbon lamps, even if he were paid a bonus for so doing. The cost of a lamp is reckoned in cents, but the cost of current to operate it during its life is a matter of dollars!"

As an instance of what this means, the following facts are given:—During the year 1917 approximately 12 million carbon lamps were sold in the United States. If tungsten filament lamps had been used, utilising such sizes as would consume about half the current required by carbon lamps, the following benefits would have been obtained:—

One-third more light would have been secured.

Three-quarters of a million tons of coal would have been saved.

Three million pounds value of electric current would have been saved.

Taking the situation in Great Britain, there were in the year 1917 approximately eight million carbon lamps used, and the savings would have been, on a similar basis, *i.e.*, substituting 30-watt tungsten lamps for 60-watt carbon lamps, as follows:—

One-third more light obtained.

Half a million tons of coal saved.

Two million pounds value of electric current saved.

In view of the above facts, it would seem in the interest of national necessity that all carbon-filament lamps should be replaced by the more efficient tungsten-filament lamps.

F. W. Willcox.

Mazda House, E.C., *June 8th*, 1918.

Billingsgate and Decimal Coinage.

Rarely has our national pride suffered such humiliation as it has over the Billingsgate case, coupled with the reception of the Decimal Coinage Bill by the House of Lords. One would have liked to see the Law Courts receive its case with chilling silence, in a quiet Court which felt that it was dealing with filth, and wanted to get rid of it as quickly as decency permitted. But outside the Court was a mob of yahoos, and inside, a nightmare in a madhouse.

Contrast the interest taken in the Billingsgate case with that given to the Decimal Coinage Bill. Here one would expect interest, public discussion, and eventual acceptance in some form or other. But to debate it there was only a small audience of old gentlemen who wanted to get to their dinner. After a short discussion, one of them got up with words which meant pretty well: "Aw, aw; this is a horrid bore. Let's shunt it." "Agreed," yawned the others. And the Bill was shunted. True, there was the inevitable difference of opinion as to the penny or sovereign basis of the new coinage. This is well worth discussion, but cannot our legislators see that difference of opinion, like that, makes it the more important to get busy at once? A committee should have been appointed right away to inquire into the matter, and the minority should have been willing to accept the verdict of the majority. One must admit, surely, that everyone cannot have his own scheme put into operation.

How many people bear in mind that Japan modernised herself in a generation, and that China is coming along? In a thousand years our mandarins would hardly have got over the period of placid objections had they been in charge of Japan. With them the *present* is never the time to strike. Time is an unending series of *to-morrows*, and they cannot conceive why anyone should be in a hurry to get work done to-day. The wait-a-bit policy is so much easier, and saves so much trouble.

It is time that the engineers bestirred themselves. To anyone who looks on the world with open eyes it is apparent that we are not in a position everlastingly to put this question to one side. We need all our wits and energies for modern languages, history, and mathematics, and we also need systems of coinage and weights and measures intelligible to our foreign customers. This muddling along with our present fuddled conglomeration of antiquities has never served us well. It need not continue to enslave us longer if only we show the requisite energy to throw it over.

June 8th, 1918. **Decimal.**

The Two Associations.

With reference to the account of a meeting held at Newcastle, under the auspices of the Local Section of the I.E.E., which appeared in your last issue, it is my duty to correct a mis-statement of fact therein.

Mr. L. L. Robinson mentioned the category of members of engineering staffs in the electricity supply industry from the grade of chief engineer to assistant engineer-in-charge, and is reported to have said :—"That class of engineer had at present no representative body to look after his material, personal, and individual interests."

By this time all the world and his wife know that the E.P.E.A. includes in its membership qualified engineers from chief to junior from both company and municipal stations. While the term "employer" may not loom so large in our ideals as it did in Mr. Robinson's speech, we trust that our humble and sustained efforts to attain our objects as published will result in advantage to all sections of the electrical industry—owners, management, and executive—and thence to the well-being of the community, which must be the final "megger."

Many provincial chief engineers and managers have joined the E.P.E.A.; the objection raised by the engineers who have held aloof has been that they could not become identified with an Association registered as a Trade Union. Now that they have performed a *volte face* and decided that, willy-nilly, such a registration is legally essential, one should have thought they would have accepted the existing organisation of the E.P.E.A. as, at any rate, the nucleus of their desires. The only serious difference that can now be found between the E.P.E.A. and the proposed Association is the somewhat higher qualifications for membership required by the E.P.E.A., and on this we fear no further concession could be made.

More credence could be put on the sincerity of their specious requests for unity had the promoters of the B.E.E.A. added the lustre of their names to the roll of the E.P.E.A., and their experience and wisdom to the deliberations of its Council rather than that Mr. Robinson should stump the country like a modern John the Baptist declaring the coming of what in these days of centralisation can be looked upon only as regrettable and inefficient duplication.

George C. Law,
Hon. Publicity Secretary,
Electrical Power Engineers' Association.

London, S.W., *June 9th*, 1918.

The Decimal System.—The report of the Decimal Association for the past year records the introduction of the Decimal Coinage Bill into the House of Lords by Lord Southwark (the discussion on the Bill was adjourned last week, and a Government inquiry into the subject is to be held). Lectures have been given throughout the country by Mr. E. C. Barton and others, with satisfactory results, and resolutions in favour of decimal coinage or the metric system, or both, have been passed by a large number of public bodies, including the British Engineers' Association, the Federation of British Industries, the Municipal Tramways Association, the Tramways and Light Railways Association, the Institution of Electrical Engineers (Manchester and Newcastle), the Institution of Post Office Electrical Engineers at four centres, and numerous Chambers of Commerce, Trade Protection Societies, Teaching Associations, Retail Traders' Associations, &c. The Chartered Institute of Secretaries voted 85 per cent. for decimal coinage and 86 per cent. for the metric system. The Trade Union Congress Parliamentary Committee raised the question of decimal reform in an interview with the President of the Board of Trade in November, 1917.

The International Parliamentary Commercial Conference, held in Rome in 1917, unanimously passed a resolution advocating the compulsory use of the metric system. The British Chambers of Commerce in Italy and Paris last year pressed for the reform, and the movement is making progress in the United States, where the effort to develop trade with South America has revealed the disadvantages of the use of non-metric units. The War Department at Washington, in January, 1918, decided that the metric system should be used in France for all firing data, operation orders, and map construction, and artillery and machine-gun material was to be graduated accordingly. The British Chambers of Commerce in Brazil and the Argentine have urged the necessity of adopting metric measures.

The loss of Sir Richard Burbidge, chairman of the Executive Committee, was very severely felt by the Association. His place has been taken by Mr. T. McKenna, and the new vice-presidents include Viscount Northcliffe and Captain H. Riall Sankey. Mr. W. L. Madgen has been elected on the Executive Committee. The income for the year was £1,940 and the expenditure £715.

British Science Guild.—The twelfth annual meeting of the British Science Guild will be held at the Mansion House on June 19th next, at 4 p.m., the Right Hon. the Lord Mayor presiding. An address on "Education, Science, and Leadership" will be given by the Right Hon. Lord Sydenham, G.C.S.I., &c., and other speakers will be Sir Algernon Firth, Bart., and Sir Henry Newbolt, D.Litt. Cards of invitation may be obtained on application to the Secretary, British Science Guild, 199, Piccadilly, W. 1.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Hollow Flue Damper.

In *Stahl und Eisen*, Frank Tokar describes a hollow flue damper to regulate the draught while in service. The damper is composed principally of two plates A_1 and A_2 (fig. 1). The side A_1 facing the grate is solid, and the side A_2 facing the flue has round its edges the slots B. The bottom edge F is slightly slanting, so that when the damper is lowered it leans on the wall next to the grate. The function of this device is the following :—As soon as the furnace

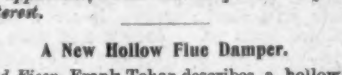


FIG. 1.—HOLLOW FLUE DAMPER.

is to be shut down, the damper is dropped to the bottom, and the shutters D are opened. The damper now completely cuts off the grate from the flue, and cold air is drawn in through the space C and the slots B from outside. When regulating the draught, if the escaping gases are very hot, the shutters D are opened accordingly ; the cold air which now circulates through the space C and out at B protects the damper and prevents it becoming over-heated. —*Le Génie Civil.*

Truck Type Switchboards.

We have received from MESSRS. JOHNSON & PHILLIPS, LTD. Charlton, London, S.E. 7, a booklet (List S 2/1—4, April, 1918), descriptive of their all-steel draw-out truck type switchboards. These boards are constructed in three standard sizes, each cubicle being made in two parts, the stationary portion bolted to the floor

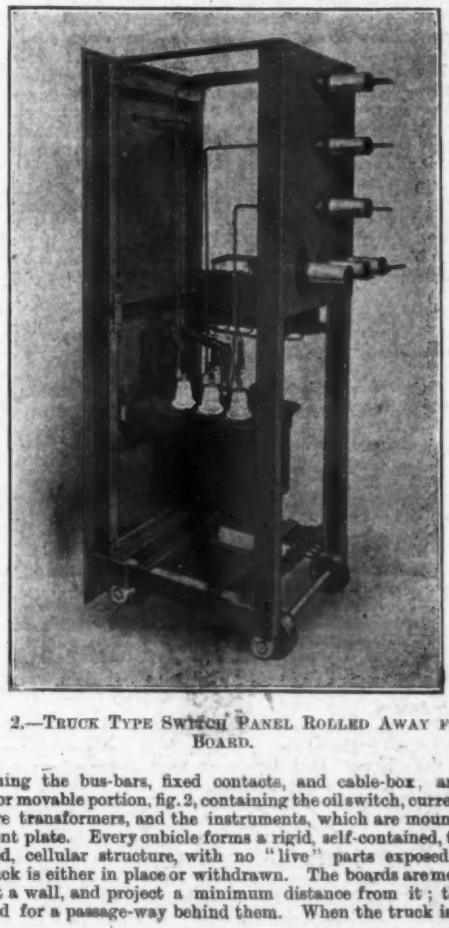


FIG. 2.—TRUCK TYPE SWITCH PANEL ROLLED AWAY FROM BOARD.

containing the bus-bars, fixed contacts, and cable-box, and the truck, or movable portion, fig. 2, containing the oil switch, current and pressure transformers, and the instruments, which are mounted on the front plate. Every cubicle forms a rigid, self-contained, totally enclosed, cellular structure, with no "live" parts exposed when the truck is either in place or withdrawn. The boards are mounted against a wall, and project a minimum distance from it ; there is no need for a passage-way behind them. When the truck is with-

drawn, the apparatus is rendered easily accessible for examination and repair, while a shutter comes into operation which completely screens the live stationary contacts. When re-entering, the truck again unmasks these, and it is then too nearly home to permit of their being touched accidentally. The most important feature in this type of board is the complete system of interlocks which it possesses. It is impossible to withdraw the truck with the switch closed, or to re-insert it with the switch in the closed position. Directly the truck moves, and the fixed and moving contacts begin to separate, it is impossible to operate the switch until such time as the truck is well away from the fixed contacts. This feature also prevents all possibility of the switch being closed before the truck is well home.

The switchboards are capable of easy extension at either end, and individual panels can be readily removed, if desired. The switches are all of the directly operated type, with "free" operating handles. They are of ample capacity and strong mechanical construction. The tanks are provided with air cushioning chambers, and designed with ample volume and head of oil over the contacts. Remote mechanically-operated truck type switchboards can be supplied, if desired, having all the features described for the directly operated truck boards.

Three-phase 6,000-ampere Switchgear.

Advances are continually being made in the size of control apparatus to meet the ever-increasing size of generating units. Fig. 3 shows a remote mechanically-operated switchboard recently made by Messrs. Ferguson, Pailin & Co., Ltd., Edward Street, Higher Openshaw, Manchester, embodying such a switch capable of carrying continuously 6,000 amperes at 650 volts.

It is difficult to combine both adequate breaking and carrying capacity in the one switch and at the same time to retain ease of operation when dealing with very heavy currents; the solution found was to provide two switches in parallel, one to carry the current and the other to break it. Over 90 per cent. of the current is carried by the main switch, which has massive brushes and contacts, but a comparatively small travel. The "snap" switch has lighter contacts, and carries the balance of the current, but has a large travel, as well as being particularly robust mechanically, to break the heavy powers dealt with. This arrangement facilitates the manual operation of the switch, in that the heavy mass has a small movement, and the light mass has a large movement. The "snap" switch is timed by the operating mechanism to make circuit first and

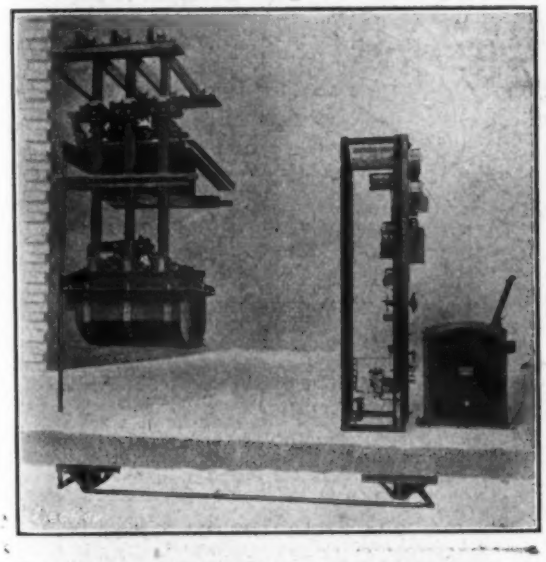


Fig. 3.—Remote Mechanically-Operated Switchboard.

break circuit last, so that all arcing takes place on the "snap" switch, and there is no fear of injuring the main contacts. Strictly speaking, no oil is necessary for the "main" switch, but it is provided to assist in cooling it. Furthermore, quick-break plunger arcing contacts are provided in case of accident to the "snap" switch. The main support consists of a 3-in. slate slab with a heavy gun-metal frame, the connections leading out of the switch, as shown in fig. 4; they are of the strip type, and the main brushes making contact directly on to the end of the strips are riveted and sweated to massive contact blocks. The "snap" switch is provided with three separate elliptical tanks capable of withstanding heavy internal pressures without permanent distortion.

The lever arrangement is of the automatic free-handle railway-signal type, with shunt trip coil. Great assistance is rendered in closing the switch by the use of two long powerful springs attached to the fixed-handle system. In moving the fixed-handle lever forward to engage with the free-handle lever ready for reclosing, the springs are extended and the energy stored is given back on the return movement. This reduces the power necessary to close the switch so much that an average woman can perform the operation with ease, and there is no difficulty with synchronising. The dimensions of the switch may be gauged from the height of the control board, which is 7 ft. 9 in. The complete switch with its lever-box weighs about 1½ tons. The connections and bus-bars are held very rigidly in mica-insulated slate blocks with gun-metal saddles to

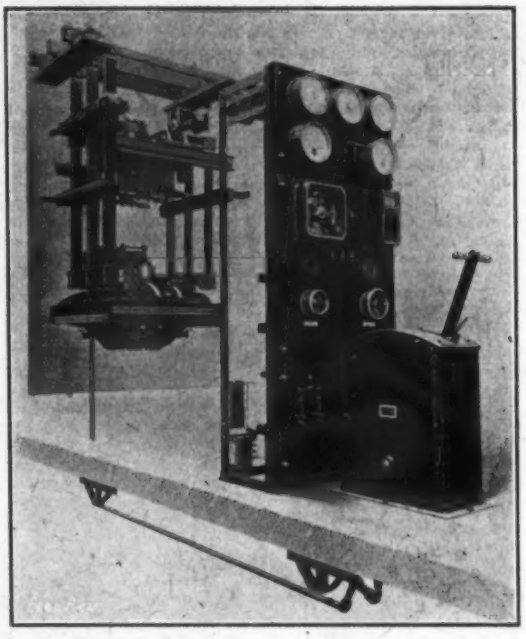


Fig. 4.—Main-Switch Connections.

prevent the bars whipping together or being thrown out of their supports on short circuit.

The Electrical Heating of Water.

In an ordinary electric water heater the water boils in a time depending on the watts consumed, the efficiency, and the initial temperature of the water. There is a loss of heat due to radiation, which reduces the efficiency and increases the time taken to boil any given quantity of water. Mr. L. O. Meyer, of 6, Grosvenor Street, Bedford, has made many experiments to stop this loss, and finally hit upon the idea of using a vacuum between the inner and

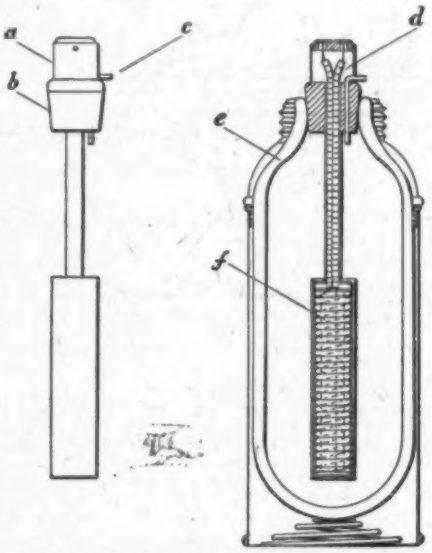


Fig. 5.—Electric Immersion Water Heater.

outer walls of the water-containing vessel, in which is placed an immersion heater; this reduced the loss by radiation to a minimum, and repeated experiments showed that the electrical efficiency was practically 100 per cent. In an actual experiment 390 cb. cm. of water was raised from 16° C. to 100° C. in 7·6 min., and after 12 hours the water had only fallen to 80° C., and boiled up in 1·9 min. The power consumed averaged 298 watts.

An immersion heater, which can be used with an ordinary vacuum flask, has been provisionally patented by the inventor, and is shown in fig. 5 herewith; *a* is an ordinary ½-in. lamp cap, to which is fitted the cork of the flask *b* and the steam outlet *c*. The heating element is wound on a fireproof tube *f*, and enclosed in a metal casing; the leads are brought up to the lamp cap, as shown at *d*. The space *e* is a vacuum between the walls of the flask. An electric heater involving the same principle is being developed on a much larger scale for use in restaurants, &c., where it is necessary to maintain boiling water at a low cost.

SOUTH WALES AND MONMOUTHSHIRE LINKING-UP.

THE interim report of the South Wales and Monmouthshire Joint Committee for the Interconnection of Electric Supply Undertakings, to which we made a brief reference last week, divides the local authorities and companies within the specified area into three groups:—

GROUP A.—From Neath westward.

GROUP B.—Cardiff, Penarth, Newport, Pontypool, and South Wales Power Co.

GROUP C.—South Wales Power Co. and adjacent undertakings, including Rhondda U.D.C., Rhondda Tramways, Pontypridd U.D.C., Merthyr Tramways & Lighting, &c.

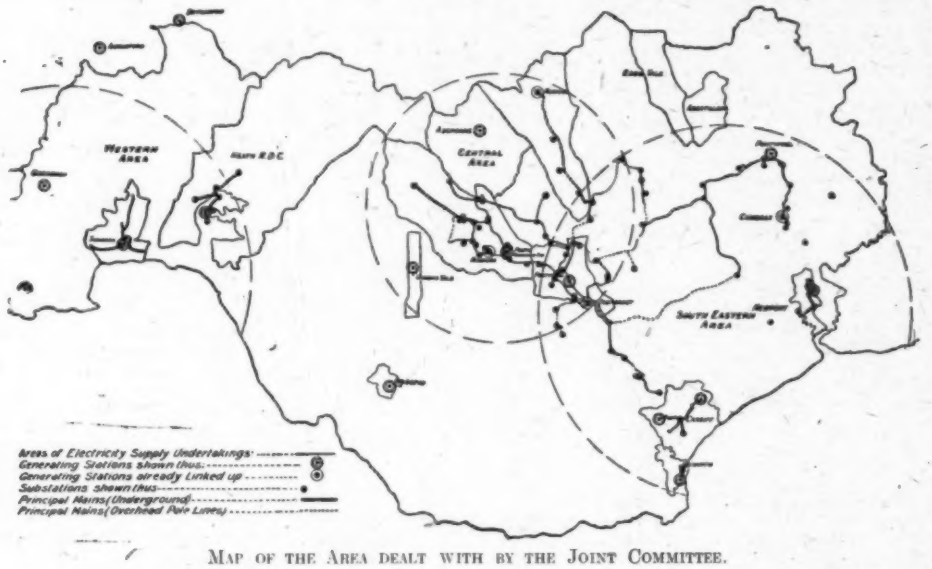
The totals and averages for these areas are as follows:—

GROUP A.—Units generated per annum, 12,788,045; coal used per annum, 19,163 tons; total coal costs, £17,806; average lb. coal used per unit generated, 3.356; average price per ton, 18s. 7d.

GROUP B.—Units generated per annum, 61,958,149; coal used per annum, 85,460 tons; total coal costs, £84,492; average lb. coal used per unit generated, 3.08; average price per ton, 19s. 9d.

GROUP C.*—Units generated per annum, 46,880,620; coal used per annum, 55,862 tons; total coal costs, £47,929; average lb. coal used per unit generated, 2.67; average per ton, 17s. 2d.

Brynamman, Carmarthen and Chepstow are undertakings the interconnection of which would not be justified at present. Deducting these undertakings, also Merthyr, Rhondda U.D.C., and Ebbw Vale U.D.C., there remained 17 undertakings to be dealt with in the report. There are private plants in the area, but the Committee decided, after communication with the "Parent" Committee, that they should not be dealt with in this report. The interconnection of Llanelly, Swansea, and Neath offered considerable possibilities, not only as to interchange of load, but further development of the respective supply areas through which the interconnecting mains would pass.



MAP OF THE AREA DEALT WITH BY THE JOINT COMMITTEE.

It is recommended that the following standards be adopted:—System of supply, 3-phase, 50 periods, 6,600 volts for generators (mostly employed in the stations concerned); 6,600 volts or multiples thereof for transformers, overhead lines, &c.; 6,600 volts or multiples thereof for underground cables.

As the periodicity of Cardiff and Newport is 50, and that of the South Wales Power Co. 25, the proposal to link up could be dealt with either by a sub-station with frequency changers situated at a central position, or the installation of frequency changers in the Cardiff and Newport Corporation power stations. The question of joint working by these three companies was considered, if feasible, as offering certain advantages, and was a proposal admitting of solution either by a combined station under joint control, or the installation of additional plant in any or all of the stations as might be necessitated by local requirements and under joint control; or the installation of additional plant at one or other of the three stations, but without joint control, the other stations taking their supply in bulk from that in which the additional plant would be installed. With regard to Penarth and Pontypool, taking a bulk supply presents no difficulties and is very desirable.

With regard to Group C, the Committee is of opinion that the only feasible way interconnection could be carried out in this group is to make use of the South Wales Power Co.

*In taking the average coal consumption in Group C, the units produced by the destructor plants have been deducted.

WAR ITEMS.

German Propaganda.—"We have learned," says the Amsterdam *Handelsblad*, "that preparations are already being made in Germany for the establishment of a Pan-German news organisation over the entire world, and that one of the first steps has been the foundation of a 'National Dutch News Agency' at The Hague."—*Times*.

Under the title "Something Rotten, &c. —" the *Newspaper World* says:—"It is interesting to note, and the report comes from good authority, that during the last two or three months no fewer than six new weekly or monthly newspapers under German control, and devoted to the promotion of German interests, have appeared in Denmark."

Electricity Staff's War Savings.—Blackburn Electricity Committee has agreed that the sum of £1,200 be advanced to the electrical engineer for the purchase of War Savings Certificates in connection with the weekly subscription for the certificates by the employés in the electricity department.

Tramways and War Bonus.—The Secretary of the Municipal Tramways Association notifies municipal tramway authorities that it is not prepared to advise the municipalities to accede to the application of the National Transport Workers for the 12½ per cent. bonus, and has appointed a sub-committee, with executive powers, to prepare the case and deal with the arbitration.

Exemption Applications.—At Rochdale Tribunal, the Corporation Tramways Committee appealed for H. Smethurst (37, Class A), overhead linesman. Mr. G. Webster, the manager, said he had a telegram in response to representations made to the Tramways Control Committee that the hearing of the case would be suspended whilst consideration was given by the National Service Council. Mr. Webster was asked if representations had been made in the case of another man who was told to join up recently, and he replied that they had. As a result, the man had not yet been taken. The case was adjourned *sine die*.

Worthing Electric Committee has asked the Town Clerk to apply to the Local Tribunal for the exemption of Mr. Porter, the electrical engineer, from military service.

The East Kent Appeal Court has granted exemption until November 30th to Colin Campbell (42, B 1), electrical engineer at the Whitstable electricity works.

At Trowbridge, a month, with fresh medical examination, was granted to E. T. Charmbury, electrician with Messrs. J. and T. Clark.

At Oxford, on June 3rd, two months' temporary exemption was granted to G. A. King (38, Grade 2), electrician at Keble College.

At Folkestone, an appeal was made for R. Clark (41, Class A), electrical engineer with Messrs. Webster & Son, and it was decided that he should not be called up for two months.

On a review, the Hastings Tribunal has granted six months' conditional exemption to F. Wordley (38, Grade 2), electrical engineer, of St. Leonards.

Before the Berks. Appeal Court, the National Service Representative appealed against exemption held by P. G. Lovegrove (35, B 1), electrician. As he has been granted a protection certificate, the exemption was cancelled.

At Windermere, extended exemption was sought by J. K. Thornborough (36, Grade 2), electrical engineer, who is now doing 18 hours per week on work of national importance. Subject to this being continued, he was given temporary exemption until August 23rd.

At Weymouth, the National Service Representative asked for withdrawal of exemption held by J. H. Bolam (42, C 3), borough electrical engineer. It was stated that if the certificate was withdrawn an injustice would be done, as respondent, who holds a protection certificate, could not appeal on occupational grounds.

At Aylesbury, further exemption was sought for A. Hearn (37, C 2), electrical engineer with Messrs. E. T. Mackrill and Son. On the ground that he is engaged upon work of national importance he was granted three months.

Before the Watford Tribunal, a review was made of the case of H. Pollard (39, C 1), collector of electricity charges for the U.D.C. General Fenton said that a year ago it was recommended to the Council that a substitute should be obtained in two months, and he suggested that a good lady clerk could do his work. The exemption was varied to two months, with a view to substitution.

Rochdale Tribunal has granted exemption until August 31st

to R. Rhodes (39, C 2), blacksmith's striker, appealed for by the Corporation tramway department, and refused a claim by E. Holden (32, Class A), motorman on the tramways, for whom a substitute has been found.

Exports to China.—The "London Gazette" for June 11th contains some additional names of persons and bodies in China to whom exports may be consigned.

BUSINESS NOTES.

Patents.—The Council of the Chartered Institute of Patent Agents has authorised Fellows of the Institute to make, as from June 30th next, an additional charge of 10 per cent. on the scales of fees recommended by the Council. See "Official Notices" to-day.

Patent Revoked.—An Order, dated June 5th, 1918, revokes Patent No. 104,793, of 1916, granted to J. O. Callender and Callender's Cable and Construction Co., Ltd., for "improvements in multicore electric cables."

Book Notices.—"Tait's Electrical Directory of Australia and New Zealand, 1918." Melbourne: P. G. Tait.—This is the third edition of a very serviceable Directory containing the chief particulars of public lighting, power and traction undertakings in Australia and New Zealand. The name of the authority, system, plant, population, consumers, prices charged, and name of manager, engineer, or other responsible official, are among the information given. It also contains a list of the plants of the collieries of New South Wales, and of the large mines at Broken Hill.

The *Faraday House Journal* for the summer term contains an article on "Three-phase and Ward-Leonard Winding Equipment," which was read before the S.A. Institute of Electrical Engineers, by Mr. A. L. Ballard, B.Sc., and various notes on current topics, &c. Referring to the report of Sir J. J. Thomson's Committee, agreement is expressed with the advantages of the metric system, but in a note it is stated that "the Committee do not definitely recommend the adoption of the metric system"; one of the "principal conclusions" of the report, however, states that "the present chaos of English weights and measures causes waste of time and confusion of thought, and that there are strong educational reasons for the adoption of the metric system." Surely that is a definite enough recommendation for its adoption.

"Workman's Time and Balance Book." London: W. F. Chalker, 64, Copleston Road, S.E. 15. Price 1s. net.—This is a handy book of forms for piece workers and others whose jobs run on for a considerable time, the forms providing for particulars regarding the jobs, time worked, &c. (60 forms), and the money drawn and owing, &c. (30 double forms). We understand that the book has met with a favourable reception amongst mechanical workers.

"*Proceedings* of the American Institute of Electrical Engineers," Vol. XXXVII, No. 5. New York: The Institute. $1.

Industry and Income-Tax.—The Chancellor of the Exchequer received a deputation from the National Union of Manufacturers and the Federation of British Industries on the subject of allowances in income-tax assessments for depreciation of plant and machinery. Mr. Bonar Law agreed to certain concessions, including allowances to be made for the first time for depreciation in the value of buildings, with a right of appeal to the Board of Referees.

Swedish Export Prohibitions.—Glass tubes, being parts of accumulators, and rectangular glass jars (for accumulators), and manufactures of wax, are now prohibited for export from Sweden. —*Times.*

Amalgamation.—Provisional arrangements have been made for the amalgamation of the businesses of Ruston, Proctor and Co. and R. Hornsby & Sons. The new name will be Ruston and Hornsby, Ltd.

Liquidations.—R.E.T. Construction Co., Ltd.—Creditors should send particulars of their debts, &c., to the liquidator, Mr. A. Page, 28, King Street, by July 25th.

Scorch Electrical Co.—The controller, Mr. C. E. Barker, 21, Finsbury Pavement, E.C., has applied for his release.

Bankruptcy Proceedings.—Birkett, W. D., factor of electrical goods, Whitley Bay.—June 27th is the last day for receipt of proofs of dividend by Mr. C. Woollett, the Official Receiver, 21, Mosley Street, Newcastle-on-Tyne.

Trade Announcement.—Messrs. Pyne Hughman and Co., Ltd., announce that their London office (High Holborn) will be discontinued as from June 22nd, after which date their business in the United Kingdom will be conducted by Messrs. Gladstone, Wyllie & Co., who have been appointed their agents for that purpose, and to whom all communications, after 21st inst., should be addressed at 36, Lime Street, London, E.C. 3. (Cables: "Wyllie, London." Inland telegrams: "Wyllie, Grace, London." Telephone: "Avenue 89.")

Plant for Disposal.—Sheffield Corporation tramways and motors department invites offers for 12 G.E. 52 traction motors. Burnley Corporation electricity department has for disposal a quantity of surplus electrical plant, including one Bellis compound engine, 12 shunt-wound motors, and six dozen arc lamps. For particulars, see our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Australia.—The year's working of the Sydney City Council's electric light undertaking, after providing for interest and sinking fund on the capital expenditure, together with depreciation charges, shows a loss of £19,870, which is attributed to the increased cost of materials, coal, &c., and the loss of revenue caused by the strike in August last. The capital invested in the undertaking at December 31st last was approximately £3,000,000.—*Sydney Daily Telegraph.*

Mobilong (South Australia) District Council, says *Tenders*, has resolved to apply for a loan of £3,500 for the installation of an electric light and power plant for Murray Bridge, electricity to be supplied by the River Murray Milling Co. The scheme includes a comprehensive arrangement of street lighting for practically the whole of the town, including lighting the railway station, goods yard, and wharf.

The Borough of Ararat (Vic.) has applied for an Order in Council authorising the Council to supply electricity for public and private purposes within the shire of Ararat.

The Liverpool Plains Shire Council is considering the question of acquiring the electric lighting system installed at Gunnedale, N.S.W., by Pike Bros. The existing agreement expires in October, when the Council has the option to purchase.

The Junee Municipal Council, N.S.W., is taking steps to raise a loan locally with which to finance an electric lighting scheme.

Batley.—Land Purchase.—A contract has been approved by the Corporation for the purchase of land at Healey for an electric sub-station.

In the case of electricity consumers serving with the Forces, the minimum charge for energy of 25s. per annum for the year ended March 31st, 1918, is not to be enforced.

Burnley.—Rate Revision.—The Electricity Committee has decided that a rental of 12½ per cent. per annum on the actual cost of motors and starters be charged on all hired in future. The Sub-Committee has been instructed to consider the scale of charges for electricity at present in force.

Canada.—Niagara Power Pooled for War Purposes. —A Canadian Order in Council provides virtually for a pooling of Niagara power on the Canadian side of the border. Sir Henry Drayton, the Dominion Power Controller, has made arrangements with the Toronto Electric Light Co., the London Electric Co., Ltd. (Ont.), and other companies, whereby those corporations will resume operation of steam power plants. The power will be at the disposal of the authorities until the needs of munitions and other essential industries are met. It is reported that Sir Henry Drayton received assurances in Washington that sufficient coal would be made available without reduction of the allotment of coal to Canada. Officials in charge of the control of power and fuel have indicated that in all probability further restrictions will have to be placed on the use of light, power, and coal by non-essential industries, merchants, storekeepers, and private consumers.—*Electrical World.*

Carshalton.—Price Increase.—The South Metropolitan E.L. Co. has notified the U.D.C. that the maximum price for energy (6d. per unit) has been increased by 10 per cent. The minimum consumption charge has been waived.

Colchester.—Loan Application.—The T.C. has applied for a loan of £5,950 for a new generating set, by which it is hoped to save £700 a year in coal.

Continental.—Norway.—A syndicate has been formed at Skien to utilise a number of small falls aggregating about 200,000 H.P. It is proposed to manufacture nitrate, aluminium, or carbide, according to market demands.

The "Norsk Hydro" annual report for the year ending June, 1917, shows a profit of 6½ million dollars against 5 millions for the previous year. The companies' capital is 15½ million dollars, and a total horse-power of 300,000 is operated for the production of nitrates and carbides. The waste heat from these electrochemical processes is now utilised in low-pressure steam turbines.—*U.S. Com. Reports.*

Spain.—Barcelona.—Shortage of coal and poor quality coal have had an adverse effect upon the quality of gas, and on several occasions Barcelona streets have been almost in darkness on this account. For this reason electric public lighting has been substituted through a great part of the city, and some 10,000 lamps of 50 and 100 C.P. have been installed. To complete the public lighting, the Compania Barcelonesa de Electricidad has asked the civic authorities for permission to run special underground mains in the principal streets and a special overhead network in the outlying districts.

Dublin.—Restricting Demand.—It is stated that the Electricity Supply Committee, as a result of coal shortage, intends to enforce a charge of 2s. per unit for electricity used in excess of two-thirds of the 1917 quantity, the arrangement to be adopted from the quarter beginning towards the end of September. Special consideration will be given to users of electric power for essential industries. Street lighting in the Dublin area has been considerably curtailed, one-third of the arc lamps and about half the number of the smaller lamps having been put out of commission, while the electric incandescent lamps in use have been reduced from 100 to 50 C.P.

Elland.—LOAN SANCTION.—At the last meeting of the U.D.C. it was reported that the Director of Electric Supply had granted support to the Council's application for sanction to borrow £2,000 for electricity extensions.

Eton.—REVALUATION.—The Assessment Committee of the B. of G. has decided to revalue the undertaking of the Uxbridge and District Electric Supply Co., Ltd., on the ground that the present profits are 200 per cent. up since the last assessment.

Lewes.—STREET LIGHTING.—The T.C. has renewed the agreement with the Electric Light Co. for public lighting for a year.

Limavady (Co. Derry).—E.L. SCHEME.—On account of the closing down of the local gasworks, the urban authorities have under consideration an electric lighting scheme for the town, which it is hoped will be in operation early next winter. There is plenty of water power available, and there is already a good private electric installation in the town.

Lincoln.—ELECTRICITY SUPPLY SCHEME.—Subject to the Finance Committee being satisfied that the necessary financial arrangements can be made, the Council in Committee has decided in favour of a scheme recommended by Sir John Snell for an electricity supply for the city, providing for the acquisition of Messrs. Clayton & Shuttleworth's power station, and its immediate extension; and that contracts be entered into with Messrs. Clayton and Shuttleworth, Ltd., and Messrs. Ruston, Proctor & Co., Ltd., for the supply of electric power. The City Council having adopted the scheme, the Ministry of Munitions is to be approached with a view to financial assistance being given, it being stated that the scheme would probably involve the expenditure of a quarter of a million pounds.

London.—PRICE INCREASE.—The City of London E.L. Co. has given notice that the war percentage to be added to charges will be at the uniform rate of 50 per cent. for electricity for all purposes. The increased charge will apply to the September quarter.

Maidstone.—SALE OF PLANT.—The T.C. has disposed of a condenser at the electricity works which on March 31st stood on the books at £384, for £475.

Morley.—YEAR'S WORKING.—Notwithstanding an increased revenue amounting to £504, there was a deficit of £1,184 on the electricity undertaking for the past year, after allowing for interest and sinking fund, as compared with £1,054 for the previous year.

New Ross (Co. Wexford).—E.L. SCHEME.—The Gas Co. has applied for liberty to extend its objects to the production of electricity for lighting and power.

Newcastle-under-Lyme.—The T.C. has approved the recommendation of the Electricity Committee to accept the offer of the Stoke-on-Trent Corporation to lay the whole of the mains, under the proposed linking-up scheme, between the central power station at Hanley and the Newcastle electricity works, subject to the Newcastle Corporation paying for that portion of the mains laid in the borough of Newcastle at a price to be agreed upon, and also subject to the approval of the L.G.B.

Nottingham.—WAR BONUS.—The employés of the electricity department, supported by the National General Workers' Union and the Tramway and Vehicle Workers' Association, are asking that the 12½ per cent. award shall be granted to them in addition to the recent advance of £1 over pre-war rates. Notices have been sent to the Committee on Production, and, if nothing is done in the matter within 21 days, action is threatened.

Arrangements have been completed by the Corporation for the purchase, at a cost of £19,000, of a large area of land, with a frontage to the river Trent, the site being one which may be used for a new generating station.

Power Co.'s Bill.—The Shropshire, Worcester, and Staffordshire Electric Power Bill has passed the House of Lords; it was stated that a clause had been inserted in the Bill, which would enable District Councils to purchase the undertaking proposed to be established in such a way as would lead to no public loss.

Ramsgate.—PRICE INCREASE.—The Electric Supply Co., Ltd., has applied to the T.C. for permission to increase the price of energy, and the Council has decided that particulars of increased charges made for electricity on account of the war shall be obtained from other towns in Kent.

Salford.—YEAR'S WORKING.—At the Town Council, Councillor M'Dougall, deputy chairman of the Electricity Committee, stated that the income of the undertaking last year amounted to £156,955, as against £173,999 the previous year, and the gross profit was £66,698 (£70,924), and net profit £13,309 (£21,253). Wages had increased fully 50 per cent. The Committee estimated its profits to be £8,500, but the Finance Committee had asked it to hand over £10,000 to the relief of the rates. They would have to ration their supply, and this would certainly affect their revenue.

Shipley.—PRICE INCREASE.—The District Council, last week, decided that as from July 1st the charge for electricity for lighting shall be 6d. per unit, an advance of 1d. The past year's working shows a net loss of £605.

Slough.—BULK SUPPLY.—The Slough and Datchet Electric Supply Co., Ltd., has applied to the B. of T. for an order permitting it to supply energy in bulk to the Windsor Electrical Installation Co., Ltd.

Stourbridge.—PRICE INCREASE.—The Midland Electric Corporation for Power Distribution, Ltd., has again increased the price of energy by 10 per cent., a total advance on pre-war prices of 50 per cent.

Sunderland.—FAILURE OF SUPPLY.—According to the *Sunderland Echo*, a complete failure of the electricity supply occurred on June 4th for nearly three hours, by which the local works and shipyards were seriously inconvenienced, and the tramway service had to be discontinued. Apparently the trouble was due to a breakdown in the boiler house of the Corporation electricity works. For some time past the department has been working under extreme difficulties owing to war conditions, which have been enhanced by the fact that a 7,500-KW. turbine which was to have been delivered last August is not yet in commission. The Electricity and Lighting Committee has under consideration tenders for the installation of additional boiler plant, which is to be proceeded with as soon as the sanction of the Ministry of Munitions is received.

Tasmania.—KING RIVER SCHEME.—The Government Hydro-Electric Department is making a survey of the King River gorge on the Mount Lyell Co.'s Railway, with regard to the suitability of that part of the river for the installation of a second power scheme. The proposal is to construct another dam in addition to the main King River scheme power dam, and to use the water from the main dam after it has passed through the turbines at the chief power station higher up the river. The banks of the river at the gorge are very steep, and the cut in the mountains through which the river passes is very narrow, so that the position is highly favourable for the development of an economical scheme. It is estimated that 15,000 H.P. can be developed at King River gorge; this, taken in conjunction with the original power scheme of 45,000 H.P. on the river, will yield 60,000 H.P. If the scheme materialises, which is deemed highly probable, the power generated will be sufficient to supply all mining and smelting works on the West Coast of Tasmania, in addition to leaving a surplus for manufacturing enterprises.—*Melbourne Age.*

In reply to an application from the Port Cygnet and Kingsborough Municipal Councils for electric light and power from the State Hydro-Electric Department, Mr. J. H. Butters, general manager, stated that no more power could be supplied at present, owing to the difficulty of getting materials and machinery. At present he thought it would probably be 15 to 18 months before power could be supplied.

The carbide of calcium producing plant established in Tasmania by the Hydro-Electric Co. is practically completed, and is about to be put in operation. An expert in carbide manufacture has been secured from Switzerland to supervise the plant.

Torquay.—YEAR'S WORK.—The financial statement of the Corporation electric light undertaking shows total income for the year ending December 31st of £19,639. After deducting working expenses, a working balance of £4,476, plus £245 value of stores, has been placed to the net revenue account. After allowing for interest £1,682, £2,899 for sinking fund charges, £637 war service allowances, and £866 for new services, the deficit on the year's working totalled £1,372. Total amount borrowed in connection with the undertaking £75,900, indebtedness at the end of the year £44,741.

Wigan.—REDUCED EXPENDITURE.—Ald. Grimshaw, referring to the report of the electricity works manager, said the coal consumption had been reduced by 7,196 tons. The average price per unit during the past year was a little lower than in the previous year, and had it compared with that year their profits would have been £750 more. They had paid £2,216 to the suspense account. The loss for the year ending March, 1916, was over £6,000; for the year ending March, 1917, it was £7,712, but the past year showed a profit of £1,091. On the items where he had direct control the manager had reduced the expenditure by £7,950.

Wolverhampton.—The Electricity Committee has recommended that the application of the Brotherton Tubes and Conduit Co., Ltd., for the supply of electricity for power purposes be acceded to, and that the necessary transformer and switchgear, &c., be provided at an estimated cost of £500.

Worcester.—YEAR'S WORKING.—The report of the city electrical engineer, Mr. C. M. Shaw, on the work of the department for the year ending March 31st, 1918, shows that the total income was £31,393, an increase of £6,215; the gross profit was £15,307, and after providing for interest, sinking fund, and ncome-tax there remained a net profit of £3,136, a record figure, in spite of extra costs of £7,000 over pre-war prices of coal and labour. The gross capital expenditure on the undertaking amounts to £205,495, of which £126,807 has been written off, leaving a net debt of only £78,688. Practically the whole of the generating plant has been modernised, and the capacity of the plant is in excess of the demand, so that the undertaking is in a very favourable position. From the Powick water-power plant over a million units have been obtained, a record output. The total output was 4,637,269 units sold, comparing well with 3½ millions in the previous year. Motors and radiators aggregate 5,535 H.P. Over 4 million units were sold for power and heating, compared with less than 3 millions in the previous year, and the revenue from

these sources was £19,704, whilst lighting only brought in £8,112. The works costs were 0·77d. per unit sold, compared with 0·86d. per unit in the previous year, a remarkable result in view of the difficulties of the times, and largely due to increased output, efficient stokers, and economical turbine plant. The engineer points out the importance of providing cheap power to attract manufacturers to the city, which is not favourably situated for inclusion in a bulk supply system, and, therefore, should continue to develop its own undertaking. During the past five years, under Mr. Shaw's management, the output has been approximately doubled, and the net profit has been continuously raised from £463 in 1914 to £3,451 in 1918. During the same period the loan capital expended has increased by only £22,515, and £34,550 has been paid off. Years ago the undertaking was by no means prosperous, but by changing over from single-phase to two-phase supply, gradually modernising the plant, and developing the power load, Mr. Shaw has succeeded in placing it on a sound financial basis.

Worthing.—YEAR'S WORKING AND PRICE INCREASE.—There was a deficiency on the electricity undertaking for the year ended March 31st last of £844. An estimated deficiency of £333 is expected in respect of the year ended March 31st, 1919, and to meet this it is proposed to make the following alterations:—All units sold for lighting by ordinary meters: fixed rate plus 50 per cent. instead of fixed rate plus 30 per cent.; all units sold by slot meters: on collection a further charge of 1½d. in every shilling; an additional charge of 6d. per quarter for meter rent.

TRAMWAY AND RAILWAY NOTES.

Bolton.—RAIL PURCHASE.—The Tramways Committee has received the sanction of the Tramways (B. of T.) Committee for the purchase of 100 tons of tram rails from Bolchow, Vaughan and Co., Ltd., Middlesbrough.

ELECTRIC VEHICLE.—The Electricity Committee has approved the purchase of an electric vehicle from Electric Mobile (Leeds), Ltd., for the use of the department.

YEAR'S WORKING.—The annual report of the Corporation Tramways Department for the year ended March 31st, 1918, shows total revenue £177,386, working expenses £102,531, gross profit £74,854, interest and repayment of loans £35,803, depreciation fund £17,105, war service allowances £1,968, leaving a credit balance of £19,978, which, with the balance of £24 brought forward from last year, amounts to £20,002, from which £15,500 has been transferred to the rates account, leaving £4,502 to be carried forward. The depreciation fund at March 31st stood at £79,146, total capital expenditure to date £574,757, loans repaid £261,861, average working expenses per car-mile, including power cost, 9·140d.; average total revenue per car-mile, 15·81d.; passengers carried, 39,581,828, an increase of 5,103,896; car-mileage, 2,692,052, an increase of 13,095 miles.

Darlington.—FARES REVISION.—The Electric Lighting and Light Railways Committee has decided to suspend halfpenny fares on the tramways for the duration of the war.

Halifax.—REDUCED SERVICE.—The Tramways Committee's recommendation of reduced service of cars and alterations of stopping places was approved by the T.C. last week. It was stated that there had recently been a big reduction in the coal stocked at the electricity works, and now there was only about a week's supply in stock. If the shortage of coal became acute, the tramways would suffer first, and would have to stop. The Tramways Committee estimated that the proposed reduced service in the mornings and evenings and early on Sunday afternoons would result in a reduction of 2,305 car-miles per week.

Leicester.—YEAR'S WORKING.—The accounts for the year ended March 31st show that the municipal tramways had a revenue of £243,000 and a net balance of £9,320. Revenue per car-mile averaged 15·289d.

Liverpool.—FARES REVISION.—The Council, last week, approved the proposed increase of fares on the tramways.

Manchester.—YEAR'S WORKING.—During the year ended March 31st last the Corporation tramways carried 240,914,369 passengers on a car-mileage of 18,540,585 miles, an increase of 21,762,385 passengers and 152,283 miles run on the previous year. Financially the total revenue amounted to £1,119,861; after deducting working expenses, £630,219, and war service allowances, &c., £156,936—total £789,155—the gross profit was £332,706, which, with interest added, amounts to £348,078. From this amount, interest, sinking fund, rent and tax charges are deducted, leaving a balance of £184,058, of which £100,000 was contributed to rates, £10,830 for income-tax, and the balance to reserve fund. The earnings per car-mile were the highest, so far, on record—viz., 14·496d., an increase of 1·723d. over 1916-17, while working expenses only increased by ·344d. per car-mile. The tramways department purchased some 30,200,000 units from the electricity department at 1·183d. per unit, and used 1·628 units per car mile; the motor-'buses ran 216,818 miles and carried 1,682,822 passengers; the 'buses cost 9·466d. per mile, including depreciation, to run, and earned 13·424d. per mile approximately.

Oldham.—TRAMWAY PURCHASE.—In connection with the proposed purchase of the Oldham, Ashton, and Hyde Electric Tramways, the B. of T. has approved the action of the local authorities along the route in requiring the tramway company to sell so much of the undertaking as is within the areas of such authorities.

Rotherham.—TRACK RENEWAL.—The Tramways Committee proposes to relay about 5 miles of track, at a cost of about £55,000, as soon as labour and material are available.

Swansea.—REFUSE VEHICLE.—As a result of a visit to Birmingham, Sheffield, Nottingham, and other places, a deputation of the Swansea Health Committee has recommended the purchase of two electric refuse lorries, at a cost of £1,200 each, for use at Swansea, and the Committee has approved of the recommendation.

Sheffield.—CAR PURCHASE.—The Tramways Committee is to purchase second-hand tramcars from the London County Council at an approximate cost of £7,500.

Tramway Statutory Maximum Fares.—The Select Committee appointed to consider the temporary modification of statutory requirements with regard to the charges for the conveyance of traffic on tramways, has issued its report. Evidence tendered by the Tramways and Light Railways Association and the Municipal Tramways Association shows that all tramway and light railway undertakings are injuriously affected by increased working expenses due to the war, wages having risen from 60 to 100 per cent., and the advance in cost of materials varying from about 100 per cent. to over 200 per cent. on pre-war rates. In addition, the increased cost of fuel, and, consequently, of power, coupled with restrictions imposed on supply, should be taken into consideration. The larger revenue earned by many tramways does not compensate for the constantly advancing working costs; but in most of the large towns, where the tramway systems are generally owned by the municipalities, there is still a margin, since the fares charged are in most cases lower than the statutory maximum. Some possibility of relief should be afforded to those undertakings which cannot increase their revenue to compensate them for the abnormal working expenses occasioned by war conditions. Although in the case of municipalities deficits can be made good out of the rates, the passenger should not be carried at a loss.

The Committee therefore recommends that the Board of Trade should be empowered by general legislation to permit the temporary modification of statutory requirements with regard to the charges for the conveyance of traffic on tramways and railways constructed wholly, or mainly, on public roads, in the case of undertakings whose financial circumstances are proved to the satisfaction of the Board to have been injuriously affected by causes arising out of the war, the word "temporary" covering a period limited to the duration of the war and two years after its termination.

Walthamstow.—EX-SOLDIER TRAMCAR DRIVERS.—It is stated that after training a large number of discharged soldiers to drive tramway cars, the manager of the tramways has come to the conclusion that when the Army discharges a man as unfit he is physically incapable of standing the strain and exposure of a motorman's life.

York.—YEAR'S WORKING.—Receipts of the tramways last year (ended March 31st last), were £40,272, compared with £36,191 for the previous year. Per car-mile the receipts were 11·23d., as against 10·47d.

CONTRACTS OPEN AND CLOSED.

OPEN.

Lancaster.—July 16th. Electricity Committee. 6, 9, and 12 months' supply of slack or nuts (screened and washed). Mr. J. B. Patterson, Electricity Works, Marton Street.

London.—L.C.C. The Highways Committee recommends that tenders be invited for the supply of cotton-covered copper wire for the tramways department.

Spain.—OVIEDO.—Transformers, motors, and accessories, makers, representatives, or importers who are in a position to supply this material within a short time, and principally static transformers of 50,000 volts and large capacity, should write to Don Narciso H. Vaquero (Saltos de Agua de Somiedo), Apartado 53, Oviedo.—*La Enérgia Eléctrica.*

Spenborough.—June 19th. The U.D.C. invites tenders for the supply of 4,000 tons of slack coal for the electricity works.

Warrington.—June 18th. Electricity and Tramways Committee. High-tension lead-covered cable and medium-tension rubber-covered cable. See "Official Notices" May 31st.

CLOSED.

Colchester.—T.C. Pump for the electricity works. Mumford & Co., £171.

Gillingham (Kent).—T.C. 640-B.H.P. Willans Diesel engine, coupled to a G.E.C. alternator with 615-K.V.A. transformer, by the British Electric Transformer Co., and apparatus for burning tar oil. Banks, Warner & Co., Ltd., £12,038.

Glasgow.—The Tramways Committee recommends the following offers for acceptance :—

Armature coils.—British Westinghouse Co., Ltd.
Trolley wire.—F. Smith & Co., Ltd.
500 tons of rails.—Bolckow, Vaughan & Co.
200 tons of rails.—Walter Scott, Ltd.

Maidstone.—T.C. 740 yd. of H.T. cable. General-Pirelli, Ltd., £603.

Other tenders were :—

Callender's Cable Co., £829; B. I. & Helsby Cables, Ltd., £814; W. T. Henley's Telegraph Works Co., £790.

Sheffield.—City Council :—

W. T. Glover & Co., Ltd.—Two feeder cables between the Blackburn Meadows power house of the Sheffield Corporation and the Rotherham Corporation power house; also for cables at revised schedule of prices.
A. Reyrolle & Co., Ltd.—H.T. feeder panel at Neepsend power house.
Davidson & Co., Ltd.—Centrifugal fan, casing, and other apparatus for ventilation of boiler house basement.

Wolverhampton.—Corporation Electricity Committee. Accepted tenders :—

Reyrolle & Co., Ltd.—Additional switchgear, £824.
Mather & Platt, Ltd.—Two pumps for cooling towers, £1,044.
Willans & Robinson, Ltd.—Changing extractor system of the rest of the 5,000-kw. turbo sets from series to shunt, and supplying the third system on the shunt system, £490.
Globe Tank & Hurdle Co., Ltd.—Air shaft for boiler house, £62.
Ferguson, Pailin & Co., Ltd.—Three sets of carbon dioxide gas recording apparatus, £50 each; two reactances, £1,577.
Alley & MacLellan, Ltd.—Two each 18-in. and 16-in. valves, £148.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, June 14th. At 7.30 p.m. Paper on "Electric Accumulators," by Mr. R. Rankin.

Electrical Power Engineers' Association (London Division).—Monday, June 17th. At 7 p.m. At St. Bride's Institute, Fleet Street, E.C. Address by Mr. A. C. Bostel on "Trade Unions and Incorporated Societies."

Midland Section.—Saturday, June 15th. At 3 p.m. General meeting.

Northern Division.—Tuesday, June 18th. At the Grosvenor Hotel, Deansgate, Manchester. At 7.30 p.m. Special general meeting.

Incorporated Municipal Electrical Association.—Thursday, June 20th. At 10 a.m. Annual general meeting at the Town Hall, Manchester. Presidential address by Mr. J. S. Watson, Borough Electrical Engineer, Bury, and Discussion on "The Failure of Electric Power Supply," introduced by Mr. S. L. Pearce. At 3 p.m. Visits to Stuart Street Power Station, and the works of the British Westinghouse Co., Ltd. At 8 p.m. Smoking concert at the Engineers' Club.

Friday, June 21st. At 9.30 a.m. Council meeting. Resumed discussion on "Electric Power Supply." Annual general meeting.

NOTES.

Engineers and the "Secret Character Note."—Irritation against what working engineers call the "secret character note," and which employers simply denominate an "inquiry note," appears to be coming to a head in the Midlands. According to the *Birmingham Post*, a rule covering the Birmingham and District Engineering Employers' Association and the National Employers' Federation makes it incumbent upon a member of either body, before engaging a man or woman, to issue an inquiry note, and on the late employer to reply. This note contains no fewer than 10 questions relating to dates of beginning and ending the last employment, the reason for leaving, character, grade of labour, rate of wages and bonus, &c. The existence and use made of this inquiry note have long been resented by the men, and, encouraged, perhaps, by the withdrawal last year of the leaving certificate, steps are now being taken by the men's Union to attempt to get it abolished. The Birmingham and Midland Allied Engineering Trades' Societies' Federation states that it regards its use as an injustice and "an infringement of the rights of freedom of contract." It is, therefore, agitating for a conference with the employers, at which it will present reasons for a cessation of the practice. The men admit that the cases of "victimisation" are few; still, they hold the custom (which dates back to pre-war days) to be objectionable, and they are evidently determined to attempt to put an end to it.—*The Machinery Market.*

Electric Furnaces.—At a meeting of the Sheffield Section of the Junior Institution of Engineers, on April 26th, Mr. Verdon Cutts read a paper on "Electric Furnaces." He described several types of small melting furnaces, but more particularly directed his remarks to electric furnaces designed for the treatment of metals, pointing out that the easy control of temperature in these furnaces gave them a great advantage over the gas or coke-fired furnaces for such work.

The same advantage was secured in the case of melting furnaces in foundries, since the risks of burning metal during delays in pouring, or through other reasons, were greatly reduced in the case of the electric furnace. The inability of the large foundries to supply steel castings on the scale demanded during the war compelled many engineering firms to consider the question of putting in their own electric furnaces. The lecturer cautioned all such to ensure that the furnace load of current was always available, as the plant could not be worked economically and effectively unless worked regularly and quickly. This was not possible where the necessary load was not constantly available, and the running of this type of furnace by night only must result in a considerable loss due to the units absorbed in preheating. He particularly dwelt on the extravagance of running a plant understaffed or with inefficient lifting tackle, and instanced a case in which he traced a loss of 38 units per ton to unsuitable lifting gear.

Ferro-alloys were generally secured from the Continent prior to the war, but necessity had compelled us to produce our own, with the result that our manufacturers had shown considerable enterprise in the rapidity with which high-grade ferro-alloys had been produced.

Training Disabled Men.—There are now more than 40 men learning trades in the classes which have been established at the Huddersfield Technical College, for discharged soldiers, under the scheme of the Ministry of Pensions. Many discharged men attend for various studies as ordinary students, but the two special classes for discharged soldiers only are in electrical engineering and boot-making. The courses are for 12 months, and the fees are paid by the Ministry of Pensions.

Thanks to the initiative of Sir Arthur Pearson, acting in conjunction with Mr. Hugo Hirst and the B.E.A.M.A., a scheme introduced by Dr. Wheeler in the United States has been adopted in this country for the employment of blind soldiers in taping armature coils, work which they can do with ease and efficiency.

Volunteer Notes.—LONDON ARMY TROOPS COMPANIES, VOLUNTEER ENGINEERS.—Headquarters: Balderton Street, Grosvenor Square, W. 1.

Orders for the week ending June 23rd, 1918, by Lieut.-Colonel C. B. Clay, V.D., Commanding.
Captain of the Week.—Capt. E. G. Fleming.
Next for Duty.—Capt. W. Hynam.
Saturday, June 15th.—Commandant's Parade at Headquarters, 2.15, for drill in Hyde Park. Dress: Service dress, drill order; haversacks and water bottles, with rifles and side arms. Every member should endeavour to attend this Parade.
Monday, June 17th, to Saturday, June 22nd.—Drills as usual.
Sunday, June 23rd.—Commandant's Parade at Waterloo Station, 8.45 a.m., for work at Esher. Dress: Service dress, drill order, haversacks, and water bottles, with rifles and side arms. Mid-day and tea rations to be carried.

C. HIGGINS, *Capt.*, R.E., *Adjutant.*

Effect of the War on Lamp-Bulb Composition.—As a result of the war, a decided change in the making of glass bulbs for incandescent lamps has come about during the past year. This change, according to F. A. Poor, of the Hygrade Lamp Co., Salem, Mass., will eventually result in the lowering of the cost of finished lamps. The importation of potash was stopped on account of the war, and to-day only a very small percentage of this material is used in lead-glass bulbs. Lime-glass bulbs have come into use as a substitute, the lime-glass bulb being made by automatic machinery instead of being blown by hand. The glass is also melted in large tanks, so that it is sometimes called tank glass, and this tends to reduce the cost of manufacture, since lead-glass bulbs are melted only in pots of small size.

Another advantage of lime-glass is its softness and quicker speed of melting as compared with lead-glass. In time this is likely to lead to faster production, and the light green colour is pleasing. The shrinkage has gradually been brought down from a maximum of 50 per cent. to 15 to 30 per cent., depending upon the extent to which a factory substitutes lime glass for lead-glass. The Hygrade Co. has found progressive improvement in shipments of lime-glass. The practice of receiving lime-glass bulbs from the glass factories all cracked off will soon become standard, and this, with experience in handling the newer material, is likely to lead to decreased shrinkage and lower production cost throughout the usual range of commercial sizes.

The Rivetless Ship a Possibility.—Electric welding as a substitute for riveting is being tested by the U.S.A. Government at four shipbuilding yards, and so far the work is proving highly satisfactory. According to recent data, the process will increase the strength of the joint at least 25 per cent. and decrease the time of building a hull nearly 50 per cent. Eminent marine engineers claim that there will be a saving in labour of 60 to 70 per cent. The machine employed is the Wilson welder. At present the plates are being lap-welded, the plates being overlapped at least 2 in. (5 cm.), sometimes more, and each edge welded down. In the future it is the intention to butt-weld the plates, in which case they will be bevelled so that when placed edge to edge V-shaped grooves will be formed, into which the welding metal will flow, leaving a welt over the top of the V. The reverse side, the one exposed to the sea, will be left perfectly smooth. By this method considerable steel will be saved which otherwise is wasted by overlapping, and, at the same time, the weight of the ship will be reduced. Plates 3½ in. (9 cm.) in thickness have been welded, this being the maximum thickness used on the particular jobs where observations are being made. The advisability of casting entire steel sections and then welding them together is also under consideration. Repair work can be done without removing the broken parts from a ship. No preheating or annealing is necessary. A novice can be developed into a satisfactory electric welding operator in 30 days, and from available data it is estimated that 30 welders can do the work of 125 riveters. The Wilson welding outfit operates on what is known as the arc principle, and consists of a motor-generator set, the generator of which is wound for 35 volts. The welding metal serves as one electrode, while the ship plates constitute the other electrode.—*Marine Review*, May, 1918.

Institution and Lecture Notes.—Junior Institution of Engineers.—On Monday, June 24th, Sir Wilfrid Stokes, K.B.E., will deliver the third Gustave Canet Lecture at the Lecture Hall of the Institution of Civil Engineers, Great George Street, at 6 p.m., taking for his subject "The Stokes Gun." Tickets for the lecture may be obtained (free of charge) from the Secretary of the Institution at 39, Victoria Street, S.W. 1.

Society of Engineers (Inc.).—The *Journal* for April contains a paper on "The Power By-Product Problem," by T. R. Wollaston, in which current ideas on thermal efficiency and the relative advantages of coal and gas firing for boilers are challenged, and the installation of producer recovery gas plant at large generating stations is advocated. The balance-sheet shows an excess of expenditure over income of £85, and the accumulated fund account shows an excess of assets over liabilities of £668.

On Monday last a special lecture was delivered before the Society on "War on and Under the Sea," by Mr. Edwin Hall, and there was a large attendance of members and friends.

Manchester Steam Users' Association.—The annual report of the Committee of Management for the year 1917 shows that 11,571 boilers were under inspection, and the revenue was £24,533. The accounts show an expenditure of £22,342 and a gross surplus of £2,191; after allowing for a war-time bonus to the staff of £1,124, and sundry special expenses, there remains a net balance of £913. The number of boilers inspected showed an increase of 348, and the income was the highest on record. No explosion occurred from any boiler under inspection and guarantee.

Association of Consulting Engineers (Inc.)—The report of the Committee for the year ending April 30th, 1918, states that war conditions have greatly influenced the work of the members, who have been burdened with negotiations with the Government Control Departments. The Committee took action with respect to private consulting work undertaken by an important Government official, and to an attack on consulting engineers by the engineer to a company, with satisfactory results. The Committee deprecates the tendency of Government Departments to include consulting engineers on their staffs or on Committees, instead of employing them as consultants in the usual manner, and urges that the work of reconstruction which will follow the war ought to be planned out in advance, so that it can be put in hand at once when peace returns. A case in which consulting engineers, acting for a water company in an arbitration, successfully maintained their right to be paid 10 guineas a day, is recorded. Two members have given their lives in their country's service, and 11 are serving with the Forces. The accounts for the year show an excess of expenditure over income of £40, leaving a net balance of £116.

At the annual general meeting, on May 27th, the chairman (Mr. Frank Gill) emphasised the leeway that was taking place in public works and the importance of making due preparation to meet the situation at the end of the war. The report and accounts were unanimously adopted, and new members of the Committee were elected:—Messrs. H. Lapworth, A. H. Preece, H. J. Rope, A. P. Trotter, F. J. Moffett, and J. A. Warren. Votes of thanks to the hon. solicitor and auditors, to the hon. secretary (Mr. A. H. Dykes), and the hon. treasurer (Mr. Lowcock) were awarded.

Overcoming the Difficulties of Long-Span Construction.—It is to the great transmission networks of the Pacific Coast that engineers continually look for important suggestions in power transmission. The Coast has continually been in the front line of progress, and the Pacific plants have had to deal with topographical conditions which have made their pole lines of very diversified and interesting character, especially since long spans have been used far more freely than in most other parts of the country.

For protection against the strains produced by changes of temperature, at least one very interesting development has been made. The strain insulator group is attached at the tower side, not directly, but to a cable passing over pulleys, and thence to heavy concrete weights inside the tower, so that the connection is a flexible one ready to yield to the necessary degree when extra strains are imposed on the cable, and so to keep the tensions uniform. Considerable progress has been made, too, by dividing the strain of long spans between groups of insulators installed in parallel, with equalising yokes when of the disk type. An article in the *Electrical World*, May 4th, contains suggestions of value to those interested in the subject.

The Association of British Electrical Engineers.—In our report of the meeting at Newcastle, last week, Mr. L. L. Robinson was erroneously designated "hon. secretary of the Supply Section." This office is occupied by Mr. A. P. MacAlister, Mr. Robinson being chairman of the Provisional Committee.

Economy in Lighting and Heating.—The main object of the Fuel Order is simply to *save coal;* it is necessary to reduce the consumption of coal by at least one quarter. But the householder may choose for himself the manner of saving it, by equating his coal, gas, and electricity on a common basis and then dividing his consumption between them at pleasure. The first step is to ascertain the maximum amount of coal—the common denominator—that one will be allowed to take per annum; deducting from this amount, in tons, the actual minimum consumption of coal with which one can rub along, the remainder multipled by 800 gives the number of units of electrical energy that may be consumed for heating and cooking; or, if the household is still unregenerate, multiplying by 15,000 gives the number of cubic feet of gas that may be used for these purposes. A separate allowance of electricity will be provided for lighting purposes, or, if desired, an allowance of gas. Owing to the importance of the products of coal when carbonised in gas works, it is not desired to restrict the consumption of gas if it can be used instead of raw coal for heating and cooking. In some areas where sufficient gas is not available, it will be necessary to reduce the coal equivalent to 12,000 ft. per ton—elsewhere, it may be possible to make it 18,000 cb. ft. Local authorities will set up Fuel and Lighting Committees to handle the rationing system, with the assistance of Local Fuel Overseers. One year's allowance of coal may be stocked, and those who can lay in their stock in the summer time are urged to do so.

We have been informed of the reasons which have rendered it imperatively necessary to curtail the consumption of coal; these reasons, we can assure our readers, are unimpeachable and compelling, and as a national duty it behoves every one of us to comply with the terms of the Order not only in the letter but also in the spirit, by exercising the utmost economy.

Recommendations issued by the Illuminating Engineering Society, with the concurrence of the Board of Trade, advise consumers to ascertain their past consumption from the local gas and electric supply undertakings, and to examine their gas and electricity meter readings. Gas fires or electric radiators should be used only when strictly necessary, and cooking should be so arranged as to use ranges for a minimum length of time, and to their full capacity whilst in use. The use of hot water should be reduced to a minimum. To avoid waste of light, inefficient types of lamps or burners should be avoided, and only the number of lamps, and the candle power necessary for the purpose, should be used. The lamps or burners should be so placed and equipped as to give the maximum illuminating effect.

Carbon filament lamps should be discarded, and in large rooms gas-filled ("half-watt") electric lamps should be used. Old and blackened electric lamps should be replaced by new ones which will give the same light for a smaller consumption

To get the best results from any lamp it should be equipped with a well-designed shade, globe, or reflector, screening the light from the eyes and directing it where it is chiefly needed. If cleanliness is neglected lamps of unnecessarily high consumption have to be used to produce a given illuminating effect. There should be sufficient light in kitchens and pantries, rooms where much reading and writing is done, and on stairways; economy may fitly be exercised in drawing rooms and dining rooms, sufficient illumination being provided from local shaded lamps on tables where meals are laid, or reading and writing is done, and the rest of the room lighted in a subdued manner. Small lights may be used in passages and halls or on landings, and should preferably only be turned on when such passages, &c., are actually in use.

"Only turn on those lamps and burners which are strictly necessary, and turn them off immediately they are no longer required."

Appointments Vacant.—Charge engineer (£200), substation superintendent (£250), engineer clerk of works to superintend plant installation for the Sunderland Corporation electricity department; two switchboard attendants (60s. + 12½ per cent.) for the Blackburn electricity department; chief engineer (£400 + 12½ per cent.) to superintend the maintenance of the engine and electrical plant at King's College Hospital; switchboard attendant (63s.) for the Battersea B.C. electricity works; junior switchboard attendant (29s. 6d. + 9s.) for the Rhondda U.D.C. electricity department; power station and depôt superintendent (£200) for combined tramway and lighting undertaking in South Wales. See our advertisement pages to-day.

The Use of Petrol.—At Lancaster Castle, last week, W. G. Birkett and Polly Birkett, of Keswick, who were summoned for wrongful use of petrol, were stated to have used a motor-cycle and side-car in Morecambe, and, when questioned by the police, produced two business cards, one bearing the name "Birkett and Hewitson, motor engineers, Keswick," and the other "The British Electric Co., Whitley Bay." In defence, Mr. Birkett said he was on business, having arranged to see the Morecambe electrical engineer, who thought of purchasing a motor-generator. He was also going to the Alhambra Theatre to see a suction plant which he understood was for sale. The defendants were fined 40s. and 20s., respectively.

Cable Temperatures.—According to the *Electrical World*, laboratory tests have definitely determined that the maximum safe working internal temperature of an 11,000-volt cable is 150° F. (65·6° C.) A peculiar phenomenon is manifested beyond that temperature. By reason of the high voltage a hysteresis effect occurs in the insulation that generates heat. Up to 150° F. this loss increases directly with the temperature, but after 150° F. is reached the curve takes a very sharp upward turn and quickly reaches the failure point. Safe operation depends, therefore, upon the ability to keep the internal cable temperature below 150° F.

The Value of Higher Steam Pressures.—In an article by Mr. J. T. Foster, in the *Electrical World* of May 11th, a statement is made of the yearly saving which can be realised from the use of higher steam pressures, with the capitalised value of this saving for various loads, coal rates and rates of capitalisation. The author states that it is probable that within the next five years operating pressures will be increased to 500 lb. or 600 lb. (227 kg. to 272 kg.), so it is interesting to calculate just what would be the probable effect on the fuel cost under those conditions. Curves are shown of the theoretical Rankine-cycle water rates and thermal efficiencies, which may be used to ascertain the money value of any change to higher pressures. The method of calculating the points is illustrated by tables, and the use of the chart for obtaining the information is illustrated by a problem worked out in detail.

Terrestrial Magnetism.—The report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, states that the mean values of the magnetic elements for 1917 and three previous years are as follows :—

	Dec. W.				Dip.	
	Deg.	Min.	Hor. force.	Vert. force.	Deg.	Min.
1914 ...	15	6·3	0·18518	0·43317	66	51·2
1915 ...	14	56·5	0·18508	0·43315	—	51·8
1916 ...	—	46·9	0·18494	0·43313	—	52·7
1917 ...	—	37·0	0·18477	0·43305	—	53·6

Electricity in Domestic Service.—At a Conference of the Association of Teachers of Domestic Subjects, held at the University of Birmingham, recently, Mrs. Carey Gilson in her presidential address urged that in these days scientific housekeeping was strongly to be recommended. Housewives must be taught how to save labour. Electricity was woman's salvation. The time had come when it should be used for washing clothes, cooking food, and cleaning and heating the houses.

Author Fined.—At the Old Bailey, last week, Henry Murray, author, was fined £100 for publishing a defamatory libel concerning Sir W. F. Marwood, Joint Permanent Secretary of the Board of Trade, whom he attacked because of his attitude toward the Gattie railway goods clearing-house scheme.

Large Gas Engines in a Colliery Power Station.—A 6,000-KW. gas-electric station utilising gas from 120 new coke ovens has been installed at the Zollverein pit (Caternberg). The amount and quality of gas available—viz., 5,700 cu. m. per hour, with calorific value 4,000 calories—yields 6,000 KW., using gas engine sets consuming 3,800 calories per KW.-hour, whereas only 3,600 KW. could be obtained by using the gas to heat boilers serving steam turbine plant. Three double-acting four-stroke twin tandem engines are installed for the 3,000-KW. sets. Cylinder diameter, 1,150 mm. ; stroke, 1,300 mm. ; maximum continuous output, 4,500 H.P. at 94 R.P.M.—*Colliery Guardian.*

Electrical Power Engineers' Association.—Since the inauguration of the West Yorkshire Section at Leeds, on March 27th, the Committee elected at that general meeting has met on seven occasions. Seven Sub-Committees have been at work respectively on the draft rules of the Association ; Whitley Report ; propaganda work and publicity ; salaries ; membership ; social arrangements and papers ; and keeping a watch on the formation of other Associations with similar or allied objects, in order to consider negotiations with them and avoid any dissipation of strength by the formation of a number of Associations.

These Sub-Committees have already done considerable work ; as an example, the Rules Sub-Committee has held nine meetings and formulated draft rules, which also set forth the objects of the Association. These have been approved by the General Committee, and are now under discussion by the National Executive Council.

The total membership of the Association is over 1,000, and this Section alone has now a membership of 104 ; all engineers engaged in the production, transmission, distribution, or utilisation of electrical power are invited to make application to the Association at once. The address of the Secretary of the West Yorkshire Section is Mr. P. Furness, 6, Ash Grove, Earlsheaton, Dewsbury.

The British Engineers' Association.—In order to meet successfully the period after this war, which will always be known as an engineers' war, engineers of all descriptions must organise and co-operate ; professional engineers are already well organised in various technical and scientific societies, but this is not sufficient —there must also be co-ordination and co-operation between the specialised branches of the engineering industry. Further, there must be co-operation between the manufacturing and technical engineers and such men as the educationalists, the chemists, the metallurgists, the accountants, the finance experts and the transport experts, and any others who are intimately connected with the engineering industry in some form or other.

The British Engineers' Association is taking steps to bring about this necessary co-ordination and co-operation through its—

"A" members, consisting of manufacturing firms ;
"B" members, consisting of bodies closely allied with the industry ; and
"C" members, consisting of individuals actually engineers, and of those intimately associated with the industry.

The first three members of the "C" section are Sir Maurice FitzMaurice, C.M.G., ex-President of the Institution of Civil Engineers ; Mr. Michael Longridge, President of the Institution of Mechanical Engineers ; and Mr. C. H. Wordingham, President of the Institution of Electrical Engineers.

The object of the new section is to bring together individual engineers of all descriptions, so that the best brains, wherever they may be found, may be utilised in the discussion and the solution of the numerous problems affecting the industry, and so that, together with the "A" and "B" sections, legislative and other results can be obtained, which otherwise would be impossible. It is intended that the section shall be a live and integral part of the Association, with adequate representation on the Council of the Association ; that in the large engineering centres branches of the section shall be formed and worked by local committees elected by the members themselves ; and that the section shall in no wise take the place of the existing Engineering Institutions, Associations and Societies, but act as a connecting link between them.

By this means it is hoped that many individual engineers will be brought into closer touch with the manufacturing engineers : the universities, the technological colleges, and the works will be brought into much more intimate contact ; manufacturing engineers will be able to benefit by assistance and suggestions from individual engineers at home and abroad ; the men best qualified to advise upon, and to carry out, any research work undertaken by the Association will be found ; the individual engineer being kept informed of the many problems engaging the attention of research authorities will be able to assist in their work by his own observations and suggestions ; assistance will be given to individual engineers in carrying out research work, developing inventions, and in making investigations known to manufacturers ; the services of individual engineers will be used to the best advantage in educational and research work, and on the numerous problems confronting the industry, such as standardisation, economical production, works arrangements, costing systems, wear and tear, &c. ; assistance will be given to individual engineers in securing appointments ; facilities will be provided for obtaining information from home and oversea sources not ordinarily accessible ; efforts will be made to improve the status and interests of individual engineers, and to influence legislation affecting them and the industry ; assistance to individual engineers will be given through the Association's offices at home, and its connections and introductions abroad will be at the disposal of members ; and that all information of interest and value will be circulated to the "C" members.

British nationality (by birth) is a *sine qua non*, and no member may hold foreign interests of a nature antagonistic to the objects of the Association, which is essentially British in fact as well as in name, and will serve British interests exclusively.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—Capt. SINCLAIR, son of the chairman of the Swansea Corporation Electric Lighting Committee, who was a charge engineer at the station there before the war, and has had a distinguished career with the Forces, has so far recovered from his breakdown in France as to be able to do light work. He had been mentioned in dispatches, and was ultimately gazetted out of the Army on May 24th with the honorary rank of captain. The Committee instructed the engineer to place Capt. Sinclair on light outdoor duties for the present.

The Glasgow Tramways Committee has approved of the recommendation that Mr. LACHLAN MACKINNON, traffic manager, be appointed deputy general manager of the department.

It is proposed to increase the salary of Mr. T. B. NUTTER, chief assistant at the Burnley electricity department, from £190 to £250 per annum.

Mr. EDWIN SEDDON, chief assistant electrical engineer, Edinburgh Corporation, was presented with a tea and coffee service by the electricity works staff on the occasion of his marriage on June 10th to Miss W. M. Lough, of Forest Gate, London.

Bury Electricity Committee has recommended to the Salaries Committee that the salary of the electrical engineer shall be increased from £650 to £750 per annum.

Bolton Town Council has advanced the salary of Mr. J. BARNARD, the general manager of the tramways department, from £525 to £700 per year. Replying to discussion, Coun. Horrocks said it was a sound commercial proposition that a well-tried and efficient servant should be recognised. The tramways manager was responsible for a capital account of over half a million ; the receipts were £177,000 a year ; the financial state of the department, the equipment, and running conditions, would bear comparison with any undertaking in the country, and all this was very largely the result of the energy and ability of the manager.

The electrical engineer to the Batley Town Council, Mr. S. D. JONES, has been granted an increase of £25 per annum.

At Bradford E.C., the Deputy-Chairman reported that, unfortunately, owing to a considerable period of over-strain the health of the city electrical engineer had broken down, and that his medical adviser had prescribed a period of some weeks' rest. The Town Clerk was requested to convey to Mr. ROLES an expression of the Committee's sympathy, and of their desire that after due treatment and freedom from duty he (Mr. Roles) may make a speedy and complete recovery.

The Bridlington T.C. has advanced the salary of Mr. F. FFRENCH, deputy electrical engineer, from £165 to £185 a year.

Mr. W. J. SOWTER, electrical engineer, Bray, Co. Wicklow, has been appointed hon. district engineer under the Coal Controller.

There were 27 applications for the position of manager of the Edinburgh tramways. Communications were received from two managers in England who stated that they would only be prepared to be considered applicants if the salary was not less than £1,250 per annum instead of £1,000, the sum mentioned in the advertisement.

The salary of the electrical engineer and tramway manager at Kirkcaldy has been increased by the Corporation from £400 to £450.

Mr. HANTON, station superintendent of Hawick, has been appointed station superintendent at Rawtenstall.

General.—The Albert Medal of the Royal Society of Arts for 1918 has been awarded to Sir R. T. Glazebrook, F.R.S.

At Trinity Wesleyan Church, Roundhay, Leeds, on June 6th, Mr. Christopher Pratt, second son of Mr. Thomas Pratt, President of the National Chamber of Trade, and head of Christopher Pratt & Sons, Ltd., electrical contractors, Bradford, was married to Miss Mary Petch, of Leeds. The bridegroom is head of an important department of his father's firm, and in that connection was presented to the King and Queen during their recent industrial tour in the West Riding. The employés of Messrs. Christopher Pratt & Sons, Ltd., sent a gift of a set of fish knives and forks.

The Edison Medal Committee of the American Institute of Electrical Engineers has awarded to Colonel J. J. Carty the Edison medal, in recognition of Colonel Carty's work in the science and art of telephone engineering.

Roll of Honour.—Private T. W. Shepherd, Lincolnshire Regiment, who is a prisoner of war, was employed at the Leeds Corporation electricity works.

Corporal T. Wolstenholme, Lancashire Fusiliers, Private A. Roberts, East Lancashires, and Corporal L. Christian, Lancashire Fusiliers, who are all prisoners of war in Germany, were employés of the Chloride Electrical Storage Co., Ltd., Clifton Junction.

Private T. Preston, of the A.S.C. (Motor Transport), who has died of wounds, was employed by Messrs. Matthews and Yates, Ltd., Swinton, Manchester.

Lieutenant K. W. Allman, R.A.F., who was killed in an accident at Lincoln whilst flying last week, was employed in the drawing office of the Peel-Conner Telephone Works, Ltd., Salford.

Private W. Spence, Durham Light Infantry, was killed in action on May 23rd. He was in the electrical fitting department of Messrs. Pease & Partners, Ltd., Esh Colliery, County Durham.

Private H. Burke, Lincolnshire Regiment, reported missing from March 21st, was employed by Messrs. Wright and Wood, electrical engineers, Halifax.

Private T. Houghton, formerly in the employ of Messrs. Dick, Kerr & Co., Ltd., is a prisoner of war in Germany.

Driver N. E. Gripper, killed whilst serving with the Society of Friends' Ambulance Unit of the British Red Cross Society with the French Army, was in civil life on the staff at the Blackburn Corporation electricity works.

Sergeant R. M. Binns, Cheshire Regiment, who is a prisoner of war, wounded, was engaged at Glossop with the Urban Electric Supply Co., Ltd. He has been recommended for the Military Medal for bravery.

Private O. G. Billingham, Manchester Regiment, formerly on the staff of the Northampton Electric Light Co., reported missing on March 23rd, is a prisoner of war in Germany.

Lance-Corporal J. Astbury, Royal Fusiliers, formerly with Messrs. Taylor, Tunnicliffe & Co., Hanley, has been killed in action.

Sergeant C. R. Morgan, R.E., who was formerly in the postal telegraph department at Barnstaple, has been awarded the D.C.M. for devotion to duty whilst in charge of testing and putting through telegraph and telephone battle lines in France.

The Military Medal for gallantry in repairing damaged telegraph lines under heavy shelling and bombing, has been awarded to Private J. Capper, who enlisted from the electrical works of the L. & N.-W. Rly. Co., at Crewe.

Captain Harold Gooch, R.E., awarded the Military Cross, was before the war lecturer in electrical engineering and physics in the Belfast Technical Institute.

Major R. G. Dunlop, R.E., formerly on the staff of Messrs. Siemens at Glasgow, has been wounded. He had previously been awarded the Military Cross.

Private T. Young, Durham Light Infantry, who has been awarded the Victoria Cross, was on the outbreak of war employed as a motorman at the Towneley Drift, High Spen, Durham.

Pioneer W. Cooper, R.E., is in hospital at Lindi, East Africa, with malaria. He was employed by Mr. W. Andrews, electrical engineer, Bradford.

Private H. Evans, Lancashire Fusiliers, killed in action on May 28th, was employed by Messrs. I. Frankenburg & Sons, Ltd., Salford.

Private J. Lloyd, Coldstream Guards, killed in action, was formerly an electrician with Messrs. Cammell, Laird, Ltd., Birkenhead.

Private W. H. Green, Somerset Light Infantry, missing since April 15th, is a prisoner of war in Germany, and wounded. He was employed by the St. Helens Cable and Rubber Co., Ltd., Warrington.

Major Brazell, R.E., who before the war was a junior charge engineer at the Swansea electricity station, has been awarded the Military Cross for services in the field. He had previously been awarded the Croix de Guerre.

Rifleman W. J. Bridge, son of Mr. Albert Bridge, of the Electrical Review, reported missing three months ago, is now officially reported a prisoner of war in hospital at Hammerstein, West Prussia.

Birthday Honours.—Like the sands of the seashore or as the stars in the firmament in number are the recipients of Birthday Honours in recognition of war work. We tender our congratulations to Mr. Horace Darwin, F.R.S., chairman of the Cambridge Scientific Instrument Co., Ltd., and a member of the Munitions Inventions Department Panel; to Mr. J. E. Thornycroft, and to Mr. A. M. Smith, chairman of the Management Committee of the Engineering Employers' Federation, upon becoming Knight Commanders of the Order of the British Empire.

The following have been made Commanders of the Order:—Mr. E. J. P. Benn, Mr. G. J. Churchward (chief mechanical engineer, G.W. Rly.), Mr. A. J. Hill (chief mechanical engineer, G.E. Rly.), Mr. E. M. Iliffe (Controller, Machine Tool Department, Ministry of Munitions), Mr. H. Mensforth (general works manager, British Westinghouse Co.), Mr. G. H. Nash (chief engineer, Western Electric Co.), Mr. J. Newlands, C.I.E. (Controller of the Central Telegraph Office, G.P.O.), Mr. W. W. Bradfield (managing director of the Marconi Co.), Mr. E. S. Shrapnell Smith (chairman of the Standing Joint Committee of the Mechanical Road Transport Association), Mr. A. W. Tait (chairman, British Aluminium Co., Ltd.), Mr. W. L. Topple (Superintendent of the Electric & Ordnance Accessories Co., Ltd.), Mr. C. H. Wordingham (Director of Electrical Engineering to the Admiralty, and President of the I.E.E.).

The list of new Officers of the Order is a very long one. Amongst others known to our readers there appear Mr. G. H. Baillie (Chief Technical Adviser on Dilution of Labour, Ministry of Munitions), Mr. H. G. Barwell (superintendent of the Eastern Telegraph Co., Ltd., at Malta); Mr. W. B. Burnie, D.Sc. (Brighton Technical Institute), Lieut.-Com. V. R. d'Almeida Campos, R.N.R. (manager of the cable ship *Colonia*), Mr. T. Fender (works superintendent of Messrs. Vickers, Ltd., Barrow,), Mr. A. P. M. Fleming (of the British Westinghouse Co.), Mr. F. P. Fletcher (Electrical Engineering Department of the Director of Electrical Engineering, Admiralty), Mr. H. A. Madge (wireless telegraphy expert, H.M.S. *Vernon*), Mr. H. B. Reynolds (Messrs. Babcock and Wilcox, Ltd.), Mr. S. Robinson (Messrs. Vickers, Ltd.); Sec.-Lieut. P. A. Sanders (Messrs. Davey, Paxman & Co.), Mr. E. H. Shaughnessy (staff engineer, G.P.O.), Mr. H. J. S. Stobart (Messrs. Chance Bros. & Co., Ltd.).

The honour of Knighthood has been conferred on Major Archibald Gilbey Gold, who has been connected with the electrical industry for many years. Sir Archibald Gold, who is a Deputy-Lieutenant and a Justice of the Peace for Essex, is a Major in the Essex Yeomanry, and took a leading part at the outbreak of war in raising a reserve regiment of this force. He joined Messrs. G. E. B. Pritchett and T. W. Pritchett when the partnership of Pritchetts & Gold was formed in 1892, and has been a director of Pritchetts & Gold, Ltd., since the conversion of that firm to a limited company in 1900. It will be remembered that Pritchetts & Gold, Ltd., amalgamated with the Electrical Power Storage Co., Ltd., in 1915, and Sir Archibald Gold remains a director of the present company. We congratulate him upon the honour, so well-merited, that His Majesty has been pleased to confer upon him.

Members of the Institution of Electrical Engineers will be pleased to learn that Mr. G. E. Franey, official shorthand writer to the Institution for many years, has received the O.B.E. in recognition of his work as personal secretary to the Secretary of State for India during his tour in India from October, 1917, to May, 1918.

NEW COMPANIES REGISTERED.

British Engineering Co. (London), Ltd. (150,638).—Private company. Registered June 5th. Capital, £8,000 in 1,900 10 per cent. ord. shares of £1 each, and 2,000 def. shares of 1s. each. Iron, brass, and metal founders, mechanical, mining, gas, aero, sanitary, civil, and water engineers, aeroplane and part manufacturers, motor engine and body builders, ship and boat builders, &c. The subscribers (each with one share) are:—R. Gill, 66, Victoria Street, S.W., consulting engineer; G. Watson, M.I.C.E., M.I.Mech.E., Walter House, Bedford Street, W.C. 2. The first directors are: R. Gill and S. B. Saunders. Solicitor: E. L. Gill, 11, Queen Victoria Street, E.C. 4.

East Somerset Agricultural Power Co., Ltd. (150,640).—Registered June 5th. Capital, £5,000 in £25 shares. Threshers, ploughers, sawyers, and general agricultural workers by means of steam, electrical, or other power, hauliers, owners and hirers of traction engines and tractors, &c. Minimum cash subscription, £2,000. The first directors are:—S. B. Bartlett, Middle Farm, Yarlington, Som.; W. Burrough, Welham Farm, Shepton Montague, Som.; F. C. Golledge, Hadspen Farm, Pitcombe, Som.; A. Hunt, Brickyard Farm, Maperton, Som.; M. R. Morrish, Manor Farm, North Cadbury, Som.; J. Pither, Old Bank House, Castle Cary, Som. Solicitors: Woodforde and Drewett, Castle Cary, Som.

Pratt Bros., Ltd., Edinburgh (10,072).—Private company. Registered in Edinburgh, May 31st. Capital, £5,000 in £1 shares. To take over the business of an electrical contractor, mechanical and general engineer, manufacturer and agent carried on by A. Pratt as Pratt Bros. The subscribers (each with one share) are:—R. Graham, 16, Chalmers Street, Edinburgh, engineer; A. Pratt, West Park Place, Edinburgh, electrical contractor; D. Pratt, West Park Place, Edinburgh, electrical engineer; M. Pratt, West Park Place, Edinburgh, engineer. The first directors are: R. Graham, A. Pratt, D. Pratt, and M. Pratt. Registered office: Dabry Electric Works, West Park Place, Edinburgh.

Edinburgh Electrical Engineering Co., Ltd. (10,065).—Registered May 24th. Capital, £3,000 in £1 shares. To carry on the business of electricians, electrical, gas, or mechanical engineers, suppliers of electricity for the purposes of light, heat, motive power, or otherwise. The subscribers (each with one share) are:—J. Flunknett, 119, George Street, Edinburgh, electrical engineer; J. A. Morton, 55, Morningside Road, Edinburgh, electrical engineer; G. Lyall, 47, Frederick Street, Edinburgh, electrical engineer; J. Beck, 101, Hanover Street, Edinburgh, electrical engineer; T. Hogg, 21, Nicholson Street, Edinburgh, electrical engineer; D. Smeaton Munro, 11, Randolph Place, Edinburgh, electrical engineer; J. Dodds, 64, Thistle Street, Edinburgh. The first directors are not stated. Solicitor: Walter Finlay.

Telephone Third Hand, Ltd. (150,680).—Private company. Registered June 7th. Capital, £100 in £1 shares. Owners of patents, &c. The subscribers (each with one share) are:—Elsie I. Norman, 337, Edgware Road, W. 2, secretary; Mrs. L. Kewley, 274, Elgin Avenue, Maida Vale, W. The first director is A. E. Ford (director of Northern Motor Co., Ltd., and of Ford Boat Co., Ltd.). Registered office: 42, North Audley Street, W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lithanode, Ltd.—Satisfaction in full on February 17th, 1917, (a) of debentures dated June 21st, 1901, securing £500, (b) of debentures dated May 28th, 1903, securing £500, and (c) of debentures dated May 6th, 1904, securing £1,200 (all notified May 24th, 1918). Also registered: Assignment on May 16th, 1918, of process of two Government contracts, to secure all moneys due or to become due to London County, Westminster & Parr's Bank.

Tees Power Station Co., Ltd.—Particulars of £600,000 6 per cent. first mortgage debentures created by resolutions of March 18th and May 7th, 1918, and secured by trust deed of last date, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued at 94 per cent. Property charged: Freehold land at Billingham, Durham, with buildings, &c., thereon, or to be placed thereon, benefit of covenant by Newcastle-upon-Tyne Electric Supply Co., Ltd., and the company's undertaking and property, present and future, including uncalled capital. Trustees: Law Debenture Corporation, Ltd.

F. A. Jennings, Ltd.—Debenture, charged on the company's undertaking and property, present and future, including uncalled capital, and machinery, plant, fixtures, fittings, tools, stock in trade and utensils of trade, to secure £5,000. Holder: E. Pedduck, 31, Cannon Street, E.C.

Thermo-Electric Ore Reduction Corporation, Ltd.—Mortgage dated May 23rd, 1918, to secure all moneys due, or to become due, from company to London County & Midland Bank, Ltd., Threadneedle Street, E.C., charged on property at Luton.

Manchester Fibrine Co., Ltd.—Memorandum of satisfaction in full on April 20th, 1918, of debentures dated July 4th and 8th, 1913, securing £400, has been filed.

Church Stretton Electric Supply Co., Ltd.—Particulars of £300 debentures created May 21st, 1918, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property and assets, present and future, including uncalled capital (subject to existing charges). No trustees.

Yorkshire Electric Wiring & Motor Co., Ltd.—Mortgage on leasehold premises at Sheffield, &c., dated May 4th, 1918, to secure all moneys due, or to become due, from the company to London County & Midland Bank.

CITY NOTES.

Siemens Bros. and Co., Ltd.

Mr. G. MURE RITCHIE presided on Tuesday, at Winchester House, E.C., at the annual meeting of this company. The annual report, which was adopted, showed that the profit for 1917, after payment of all loan and debenture interest, was £213,524, before allowing for munitions levy and excess profits duty. Dividend 10 per cent., free of tax (against 7 per cent.), paid in January last, and £209,890 is carried forward, against £61,365 brought in. Cash position:—Sundry debtors, &c., £461,783; cash and Treasury bills, £125,120; investments in Siemens Bros. Dynamo Works, Ltd., £400,000; other investments, £56,085; materials, manufactured goods, and work in hand, £764,524; total, £1,807,512. Less debts and loans, £1,155,838; surplus, £651,674.

The chairman said that they met at a juncture of no small importance in the financial and industrial history of the company, and he was pleased to meet them for the first time as chairman of Siemens Bros. & Co., Ltd., which was one of the oldest—if not the oldest—electrical manufacturing firms in the United Kingdom, the business having been started as far back as 1858 in Millbank Row, and there employing about 100 men. In was incorporated with the larger factory at Woolwich in 1865, and had now grown to large dimensions. The past policy of the company had been continued throughout 1917, during which the business exceeded that of 1916 by about one-third, and, of course, like all other large engineering firms, they were engaged almost exclusively on war work. The expansion in output occurred principally in insulated wires and cables, ebonite and batteries, but also the development in automatic telephony, which was foreseen by this company before the war, was continued on a considerable scale. They were equipped to provide both large exchanges for public service and smaller private exchanges of 25 to 500 lines, and, notwithstanding the demands upon them for war work, they had found it possible to complete a semi-automatic exchange at Port Adelaide (1,000 lines) for the Commonwealth of Australia, which had been working quite satisfactorily for 18 months, and a full automatic exchange for Grimsby (1,300 lines) for the General Post Office, which would very shortly be handed over, and to make good progress with a full automatic exchange for Stockport (950 lines), also for the General Post Office. Many private exchanges of from 25 to 200 lines had been established in munitions factories. Some 1,154 of the company's employés had joined the Colours, and these included the only son of Mr. George Chauvin, their managing director. The expansion of the business had caused a considerable increase in the number of employés. Whereas before the war they employed about 4,000 persons, of whom 1,100 were females, the number was now over 5,600, including 2,600 females. The proportion of males to females, which before the war was three to one, was now about equal. Their relations with the staff and workpeople had been and were good. Proof of the happy relationship existing between the company and its employés was afforded by the long service of many of them. A continuous service of 50 years with the company was not uncommon—in fact, three had reached their jubilee of service with the company this year. The profit of £208,525 showed a substantial increase over that of the preceding year, attributable to the very much larger volume of business done. An interim dividend of 10 per cent., free of income-tax, had been paid, but no further distribution for the year 1917 could properly be considered until the Government claim for excess profits duty had been adjusted. After obtaining the opinion of Sir John Simon, K.C., they found it necessary to reconstruct the accounts of the Dynamo Co. for 1914, 1915, and 1916, a matter involving considerable labour and time, which delayed the completion of the Dynamo Co.'s accounts for 1917. There were other matters also affecting the assessment to excess profit duty which had to be dealt with. In the balance sheet the most important item on the assets side was the entry of £764,524 for materials, manufactured goods, and work in hand. This was more than double the corresponding pre-war amount, which at December 31st, 1913, was £377,385. The increase was due entirely to the growth of expenditure on orders in hand, the value of which exceeded a million and a half at December 31st last. Another important item among their assets was the company's holding of the whole of the issued capital of Siemens Bros. Dynamo Works, Ltd., namely, £200,000 in shares and £200,000 in debentures. At the outbreak of the war the share capital of this company—that is, Siemens Bros. & Co., Ltd.—amounted to £600,000, with £150,000 in 4 per cent. debentures ranking in priority thereto, nearly all the shares and about one-third of the debentures being held by Germans. Moreover, the German shareholders had supplied about £1,350,000 of additional capital to meet the requirements of the growing business of Siemens Bros. and Co. and Siemens Bros. Dynamo Works. In accordance with the provisions of the Trading with the Enemy Amendment Act, 1916, the whole of the German interest in the shares and the additional capital before mentioned was vested in the Public Trustee, who took steps to realise it by sale to a British buyer. Tenders were called for, and considerable interest in the sale was aroused. On December 14th, 1917, a sale was effected of the share capital of Siemens Bros. to Messrs. C. B. Crisp & Co. An important provision of the contract of sale was the issue to the Public Trustee by this company of debentures to the amount of £1,330,000, to bear interest at the rate of 4½ per cent. per annum, in order to provide for the repayment of the capital (other than share capital and the participation in the 4 per cent. debentures) employed in the business by the former German proprietors. The company agreed with the Public Trustee that he should have the right, after the conclusion of Peace, to call upon the company at one year's notice to redeem such debentures. Subject to such arrangement they were redeemable by annual drawings calculated to extinguish the whole in 25 years from the date of their issue. The issue of these debentures to the Public Trustee replaced in the company's books the German portion of the item of £1,155,838 shown in the balance sheet now in their hands, and other sums owing by the Siemens Dynamo Co., which were not disclosed in the balance sheet, but which would duly appear in that of the Dynamo Co. On the completion of the arrangements between the Public Trustee and the British purchasers of the German-owned shares the board was reconstituted, and was now composed of the following:—Mr. G. Mure Ritchie (chairman), the Rt. Hon. Sir William Bull, M.P., Sir Clifford Cory, Bart., M.P., the Rt. Hon. Lord Queenborough, Mr. H. J. Thomas, and Mr. G. Chauvin, the last-named being the managing director. Since the new board was formed attention had been given to many questions concerned with the development of Siemens Bros. into a great national manufacturing asset, and little time had been available for discussing a scheme of rearrangement of the share capital. The subject had, however, been under consideration, and the board recognised the advisability of so changing the capital arrangements as to make them conform with the ordinary practice of British companies. Equilibrium must be established between the share capital and the debentures, and with this object the board might at an early date ask the shareholders to approve a scheme for enlarging the share capital to £1,500,000, or to an even greater sum, in shares of £1 each. Of that number a substantial portion would remain in reserve for future developments, but as to 400,000, if issued for cash, the proceeds would be available for the retirement of a corresponding amount of debentures, thereby anticipating, in part, the post-war contingency which confronted the company. If the matter be carried through on the lines now roughly indicated, the joint concerns—that was, Siemens Bros. and Siemens Dynamo Works—would be represented by an issued share capital of £1,000,000, a debenture issue of £150,000 carrying interest at 4 per cent. per annum, and the second debentures issued to the Public Trustee, amounting to, say, £1,000,000, carrying interest at 4½ per cent. per annum. These readjustments were all subject to negotiations which must be conducted with the authorities concerned, but he thought that, as the Board of Trade desired that the company should be so assisted in its developments as to ensure its future expansion in British hands, they were justified in believing that

sympathetic consideration would be given by the authorities to their proposals for the financial reconstruction of the company when they were put forward. Coming to Siemens Bros. Dynamo Works, Ltd., which, as already stated, was entirely owned by Siemens Bros. & Co., the main features of the Dynamo Co.'s trading for 1917 as compared with 1916 was an increased turnover in the United Kingdom and a decrease overseas. The value of unexecuted orders at December 31st last was £1,145,000. The Dynamo Co., in association with Siemens Bros. & Co., had purchased £50,000 of War Loan, and had given temporary financial assistance to the extent of several thousands of pounds to War Savings Associations among the employés. Prior to the war the Dynamo Co. employed 3,389 persons, of whom 328 were women. It now employed 2,439 persons, including 650 women. Thus the proportion of men to women, which before the war was 10 to one, was now about four to one. Since the entry of the new directors into office, negotiations had been set on foot with other British companies doing similar industrial business with the object of bringing such manufacturers together for the reduction of unnecessary competition, and the avoidance of duplicating machinery, staffs, workshops, and offices. Such co-operation would make for the more continuous running of plants, the employment of more labour, and greater regularity in the volume of such employment, with the attendant advantages of cheaper production, increased efficiency, and improved quality. It meant the avoiding of unnecessary expense in storage and in selling organisations, and reduced to a minimum the duplication of stocks. An even more important advantage aimed at was the amalgamation of designing offices and the interchange of the accumulated experience of all the participants, their designs and methods. This, again, meant reduction of expenditure and increase of efficiency. The advantages arising from such industrial alliance would, moreover, make it possible to carry out complete installations within the allied group. Alliances of this nature had already been arranged with Messrs. Dick, Kerr & Co., Ltd., in the field of dynamo installations in all its ramifications, and other alliances were in contemplation. From the earliest days scientific research and experimental work of a high class had been a feature of this business. The staff of Siemens Bros. & Co., Ltd., and Siemens Bros. Dynamo Works, Ltd., contained about 25 university men, and it would be a feature of their policy to encourage the employment of men of that class, because they all recognised that in the future, far more even than in the past, they would be in an era of the more scientific development of industry.

Delhi Electric Tramways and Lighting Co., Ltd.

During 1917 the gross receipts of the tramway undertaking were £13,343, and those of the electric supply undertaking £25,785, representing increases of 20 per cent. and 12½ per cent. respectively over the figures for 1916. The net revenue of the combined undertakings was £15,119, against £11,593 in 1916. As present conditions have increased all items of expenditure and necessitated restrictions, the increase is regarded as satisfactory. After meeting expenses, paying debenture and loan interest and Indian income-tax, also putting £5,000 to depreciation of plant and equipment and £1,500 to reserve for renewals, the profit is £4,419, plus £1,089 brought forward. A dividend of 4 per cent., less tax, on the preferred shares is to be paid, and £1,508 carried forward. The plant and equipment, including rolling stock, have been maintained in good condition, notwithstanding difficulties of obtaining spare parts of all kinds, and the cost has been charged to revenue. Plant additions during 1917 cost £8,964. The new 350 B.H.P. Diesel engine was put into operation in April 1918. Increased demand for current during the winter necessitated the working of the plant under unfavourable conditions. The situation was met without undue hardship to consumers. The provision of other necessary plant, equipment and mains must remain in abeyance for the present.

Anglo-Argentine Tramways Co., Ltd.

The report for 1917 shows that the receipts were £2,783,412, and the working expenses £2,051,746, leaving £731,665, plus interest on investments, &c., £38,321, and £50,969 brought forward. Annuity to the City of Buenos Aires Tramways Co. (1904), Ltd., absorbs £70,660, interest and sinking funds on debenture stocks £587,821, sinking fund for redemption of preference and ordinary shares £6,485, interim dividend on 5½ per cent. cum. first pref. shares for half-year ended June, 1917, £88,000, leaving balance of net revenue carried to 1918 £67,990. The traffic receipts for 1917 showed an increase of £47,776, and the passengers carried were 324 millions odd, an increase of 5,811,811. The abnormal cost of fuel continued during the year, and the electric traction expenses, were £639,541, which, after allowing for the additional mileage run, is £273,784 in excess of what these expenses would have been if the cost of fuel had continued on the pre-war basis. In all other items of expenditure the strictest economy continues to be exercised. Capital outlay on works has been restricted to £41,213. In view of the uncertainties regarding the provision and cost of fuel, owing to the scarcity of tonnage, the heavy ocean freights, and the decrease of labour, the directors are unable at present to recommend the distribution of a final dividend on the cum. first pref. shares for the second half of 1917. A tribute is paid to the able management of Mr. Pedriali, and to the loyalty of his staff, which have enabled the tramway services to be continued, notwithstanding great labour unrest in the Argentine. The general manager reports on the outlook as follows:—

> There are good prospects as to a revival of business in general, consequent upon the settlement of the purchase by the Allied Governments of our excess crops at fixed minimum rates, and the opening of large credits in favour of the British and French Governments. The results of this excellent arrangement, and the abundant grain harvests and improved general prospects are that business has improved all round and upon a sound basis, and although there is a lot of leeway to make up, there is no doubt that affairs have decidedly taken a turn for the better. The number of empty houses and flats has decreased. We are already beginning to feel the effects of this improved state of affairs on our traffic. Expenses per car kilometre, always excluding the cost of current, will be kept down to below the level of last year, in spite of considerable increases allowed to some of our workmen, and reduction in working hours. Of course, the price of current is the one unknown quantity in these times, and will, I am afraid, be higher than ever this year.

Kalgoorlie Electric Power & Lighting Corpn., Ltd.—During the year the cost and difficulty of carrying on the business have been continuously cumulative. The effects of the shortage of labour and of shipping are more evident and more felt as the months and years go by. Prices of all requisities are higher, and it is difficult to get some essential things shipped at all. The profit amounts to £15,911, a decrease of £2,907, which is rather less than was anticipated. £6,000 was distributed as preference dividend, and £6,000 was placed to the credit of the debenture redemption fund. The debenture debt has been reduced from £61,200 to £30,000, and a further reduction of £7,500 has to be made at the end of this year. In view of this obligation, the directors were unable to recommend the payment of a dividend on the preference shares in April last. The balance sheet now shows that the sum carried forward is insufficient to permit of any further dividend being paid until the profit of the current year has been ascertained, and provision made for debenture interest and repayment, and for heavier claims for income-tax. The property has been maintained in good condition, and the plant and machinery in thorough working order. No important consumer has ceased to take current, but nearly all customers are taking less than before the war.

New General Traction Co., Ltd.—For the year ended March 31st the revenue amounted to £18,575. Profit £11,040, plus £8,070 brought forward, making £19,110. The directors recommend a dividend of 4 per cent., less tax, carrying forward £8,630. A dividend of 2 per cent. was paid by the Norwich Electric Tramways Co. for the year ended June 30th, 1917. The Douglas Southern Electric Tramways system is still closed down on account of the war. The income received from the Philadelphia undertaking for 1917 amounted to £13,859 after deduction of American income-tax.

Bombay Electric Supply & Tramways Co., Ltd.—Total revenue for 1917, including sale of current to the tramways, £439,850, an increase of £65,383, or 17.77 per cent. Total expenditure £183,457, an increase of £26,769, or 17.08 per cent. Net receipts £256,393, an increase of £39,614, or 18.27 per cent. After paying debenture interest, putting £43,333 to depreciation, providing for excess profits tax, and contributing to the provident fund, 6 per cent. is paid on the pref. shares, and 10 per cent., plus a bonus of 4 per cent., free of tax, on the ordinary shares, leaving £6,768 to carry forward, after paying a month's pay to officers and employés by way of a bonus, absorbing £4,900.

United River Plate Telephone Co., Ltd.—The gross earnings for 1917 were £793,670, and the gross maintenance and other charges in Argentina and London were £528,252, leaving £265,418 profit. After paying debenture interest, preference dividend, and a total of 8 per cent. for the year on the ordinary shares, free of income-tax, £2,000 is put to the staff provident fund, £60,000 to reserve, £40,000 to reserve (war contingencies) fund, and £17,308 is to be carried forward.

British Insulated & Helsby Cables, Ltd.—According to a financial daily, at an extraordinary meeting held at Liverpool last week, a resolution was unanimously passed providing for alterations to the articles of association so as to enable the directors to capitalise the undivided profits, and to distribute them among the shareholders in the form of ordinary shares.

Submarine Cables Trust, Ltd.—For the year to April 15th revenue amounted to £27,694, and expenses to £1,773, leaving £25,921. After providing £14,802 to meet payment of coupons, £11,093 has been transferred to redemption fund, leaving £93 to be carried forward.

Calcutta Tramways Co., Ltd.—Final dividend 5s. 6d. per share, making 8 per cent. for the year, free of tax; to reserve for depreciation, &c., £25,000; to staff provident fund, £1,299; carrying forward, subject to excess profits duty and Indian super-tax, £8,434.

Telephone Co. of Egypt, Ltd.—The "Times" states that the directors have announced their intention of redeeming the outstanding 4½ per cent. debenture stock on November 30th at the redemption price of 107½ per cent.

Vulcan Boiler & General Insurance Co., Ltd.—Interim dividend 9 per cent. (4s. 6d. per share), less tax, on ordinary shares.

Brazilian Traction, Light & Power Co., Ltd.—Quarterly dividend 1½ per cent. on the cum. pref. shares.

Yorkshire (Woollen District) Electric Tramways, Ltd.—Revenue for 1917 £84,585, against £76,140 for 1916. To renewals fund £10,600, to reserve £5,614, 6 per cent. dividend or ordinary shares, carry forward £5,129.

Brush Electrical Engineering Co., Ltd.—Dividend on ordinary stock for years 1916 and 1917, 6 per cent. per annum; to depreciation £7,331 and £699, general reserve £12,674, carried forward £12,700.

STOCKS AND SHARES.

TUESDAY EVENING.

INDUSTRIALS claim the most attention in the Stock Exchange. Other markets are steady, and there is more business doing than there has been lately, but dealing conditions do not get easier. Money absorption by the National War Bonds, added to the settling-up of their affairs by middle-aged men who expect to be called up sooner or later, continue to be deterrents to fresh enterprise, so that the man who buys, equally with the man who sells, tends to feel dissatisfied with the prices at which his agents carry out his orders, he not grasping the increasing difficulties that attend negotiations of stocks and shares. The news from the Western Front continues sufficiently serious to add an element of discouragement to activity in the House. Once more it must be noted that far more interest centres upon Conduit Street, the White City, Holloway Road, and other similar places now well known to Londoners of the new military age, than does Throgmorton Street.

The Electricity Supply market is dull, shares being disposed to give way where they move at all. Bromptons are 5s. down, and so are "City Lights." St. James's and Metropolitans are both ¼ easier. The two County of London issues, however, are nominally advanced. The reason given in the Stock Exchange for the depression which has overspread the list as a whole is that there are two or three deceased accounts overhanging the market, and that the lines of shares in these are rendered more difficult to place by reason of the caution induced by the rationing of electricity to householders. Those companies which depend largely upon their power business are naturally less likely to feel any ill-effects from this cause than are those which concern themselves chiefly with domestic lighting. Circles which are well informed claim, however, that the reduction of one-sixth in ordinary lighting is not likely to make much difference to the profits of companies engaged in supply, but, of course, until this is verified, it can hardly be expected that the average investor will be tempted to buy electricity shares. Meanwhile, it may be noted that the City Co. announces a further increase in price to its consumers: the new rate will be 50 per cent. higher than that prevailing on the outbreak of war.

The Manufacturing group is firm. The Brush report, commented upon here last week, has had a good effect. The gross profit is over £20,000 up, and expenses rose £2,600, while the company has wisely set aside £15,500 for maintenance, which is nearly £6,000 more than last year. The general reserve gets £12,700, an increase of £5,600, and, as mentioned before, the Ordinary stock will have a dividend of 6 per cent. for each of the years 1916 and 1917. The Ordinary stock has not changed hands since the issue of the report, the nominal price being 55—65, and the last business being marked at 44 a month ago. The 4½ per cent. Second Debenture stock, which, of course, will receive its interest at the end of this month, is quoted 49-52, so that the yield comes out to over 9 per cent. on the money. The First Debenture stock stands at 60½, and the 5 per cent. Prior Lien Debenture stock at 75, though in the case of all the issues there is little stock on offer. The Calcutta Tramways Co. has declared a dividend, making 8 per cent. free of tax for the year, comparing with 9½ per cent., less tax, for the previous twelvemonth. This, of course, is an improvement, and the Ordinary shares have risen to 7, the Preference being 4, and the 4½ per cent. First Debenture stock 73. A slight recovery in London United Tramways 4 per cent. Debenture stock raised the price to 38.

One of the features in the industrial market is a sharp rise in Marconis, the price putting on 5s. at 3⅞. No explanation was forthcoming in the market, except an expectation that the Marconi Marine Co., in which the parent concern is largely interested, is on the point of publishing an excellent report. Marines rose to 2⅞, Americans are better at 23s., and Marconi Preference at 2¾ are ¼ higher.

Cable stocks and shares have again improved upon their previous rises. Eastern Extensions have risen to 15¾, bringing them level with Western Telegraphs, and Easterns at 158½ are a point up, standing this much higher than the shares of the two companies just mentioned. Indo-Telegraph gained another 10s., and other members of the group are very firm. United River Plate Telephone have improved to 7 5/16, and Chile Telephones hold the gain of 10s. acquired last week. West India & Panama Firsts hardened to 8¼. In the manufacturing list, Henleys at 21 are 5s. higher, General Electric Ordinary at 21½ are 15s. up. India-Rubber shares have again spurted, a rise of 12s. 6d. taking the price to 16½. Amongst the engineering shares, Babcock & Wilcox have recovered to 3⅞. Iron and Steel shares generally are harder, and there is a very good tone about the market as a whole.

The home railway list keeps steady, without, however, sufficient business occurring to affect quotations to any appreciable extent. Districts put on another ¼ at 15½, the fare-raising possibilities being regarded as the reason for the slight demand for the stock, and Metropolitans at 20½ have replaced the fraction which they shed last week. Underground Electrics have not moved.

The Anglo-Argentine Tramways Co. has done badly on account of the abnormal cost of fuel, and the report is distinctly disappointing. The company postpones the final dividend on its First Preference shares, thereby dashing the hopes of those who had expected the company to make a better showing in respect of the last six months. No changes have been marked against the company's issues, but the market, of course, is not so firm as it was. Brazilian Tractions subsided a point. On the other hand, British Columbia stocks are rather better, both the Preference and Preferred improving. Mexicans hold their recovery, and the various Brazilian Tramway bonds are also steady at the advanced prices.

Notwithstanding the further reduction in the price of rubber, rubber shares are generally harder, buying from the provinces having a good effect upon an oversold market. The armament shares also are better, on the idea that official details will be published almost at once in connection with the merger between the undertakings engaged in explosives. Of base-metal shares, the best showing continues to be made by those in the New South Wales group. There is not much doing in the shares of the companies connected with tin and copper.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1916.	Dividend 1917.	Price June 11, 1918.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	9	10	6¼	— ¼	£7 13 10
Charing Cross Ordinary	5	4	3½	—	6 3 1
do. do. do. 4½ Pref.	4½	4½	3½	—	6 18 6
Chelsea	3	5	3	—	8 6 8
City of London	8	8	11½	— ½	6 19 2
do. do. 6 per cent. Pref.	6	6	9½	—	6 0 4
County of London	7	7	10½	+ ½	6 13 4
do. do. 6 per cent. Pref.	6	6	10	+ ½	6 0 0
Kensington Ordinary	6	7	5½	—	6 13 4
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	4	5	3½	—	7 13 10
Metropolitan	3	4	8¼	— ¼	6 8 0
do. 4½ per cent. Pref.	4½	4½	3½	—	6 13 4
St. James' and Pall Mall	8	9	6½	—	6 11 0
South London	5	5	2⅝	—	7 2 4
South Metropolitan Pref.	7	7	21/-	—	6 13 4
Westminster Ordinary	7	9	6½	—	7 8 10
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	94	—	6 7 8
do. Def.	1½	1½	22	—	6 14 10
Chile Telephone	8	—	8½	—	4 17 0
Cuba Sub. Ord.	7	7	9½	—	*7 3 7
Eastern Extension	8	8	15¾	+ ¼	5 1 7
Eastern Tel. Ord.	8	8	158½	+1	*5 1 0
Globe Tel. and T. Ord.	7	—	15	+ ¼	*4 13 4
do. do. Pref.	6	6	10	—	6 0 0
Great Northern Tel.	24	22	38	—	5 15 9
Indo-European	13	—	49½	+ ½	6 5 1
Marconi	15	—	3⅞	+ ⅛	4 17 10
Oriental Telephone Ord.	10	—	44/-	—	2 7 9
United R. Plate Tel.	8	8	7 5/16	+ ⅛	*5 9 4
West India and Panama	6d.	9d.	1¼	—	*8 6 8
Western Telegraph	8	8	15¾	—	*5 1 7
HOME RAILS.					
Central London Ord. Assented	4	4	62½	—	6 8 0
Metropolitan	1	1	20½	+ ½	4 16 5
do. District	Nil	Nil	15½	+ ¼	Nil
Underground Electric Ordinary	Nil	Nil	1½	—	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	6	4	76½	—	*5 4 7
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅞	—	6 6 4
Anglo-Arg. Trams. First Pref.	5½	5½	8	—	—
do. do. 2nd Pref.	5½	—	2½	—	—
do. do. 5 Deb.	5	5	63	—	7 18 10
Brazil Tractions	—	—	42	—1	—
Bombay Electric Pref.	6	6	9½	—	6 6 4
British Columbia Elec. Rly. Pfcc.	5	5	61½	+1	8 2 8
do. do. Preferred	Nil	Nil	43½	+1	Nil
do. do. Deferred	Nil	Nil	25	—	Nil
do. do. Deb.	4½	4½	63	—	6 15 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	37½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	30	—	Nil
Mexican Light Common	Nil	Nil	20	—	Nil
do. Pref.	Nil	Nil	26½	—	Nil
do. 1st Bonds	Nil	Nil	37½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3⅞	+ 1/16	4 9 0
British Aluminium Ord.	10	10	1½	+ 1/16	6 18 6
British Insulated Ord.	20	20	3½	—	5 6 8
British Westinghouse Pref.	7½	7½	9⅞	—	6 9 4
Callenders	20	—	17½	—	5 16 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	22	20	3 5/16	—	6 0 10
Edison-Swan, fully paid	—	—	2⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	75½	—	5 6 0
Electric Construction	7½	10	1 7/16	—	7 12 4
Gen. Elec. Pref.	6	6	10½	—	5 15 8
do. Ord.	10	10	20½	+ ½	4 18 0
Henley	25	25	21	+ ½	5 19 1
do. 4½ Pref.	4½	4½	5½	—	5 12 2
India-Rubber	10	10	16½	+ ½	*6 3 1
Telegraph Con.	20	20	42½	—	*5 13 0

* Dividends paid free of Income Tax.

INSTRUMENTS FOR CENTRAL-STATION SWITCHBOARDS.

By G. W. STUBBINGS.

The switchboards of a modern central station giving D.C. low-tension, E.H.T., and traction supplies are an exceedingly important section of the whole plant, and in works of even moderate output will occupy considerable space. The function of a switchboard is of a dual character, in that on it are assembled both the switch and control gear, and also the measuring instruments. The number of these latter is considerable, and their cost is a large percentage of the total cost of the whole switchboard. It is, therefore, desirable to know with some amount of certainty the degree of accuracy requisite with instruments for certain specific purposes. Instruments with accuracy superior to that required for their purpose will increase the cost of the switchboard without any corresponding advantage being obtained, while the provision of instruments of accuracy inferior to that called for by circumstances will be even more undesirable, and the consequences of such lack of accuracy may be far-reaching.

The majority of switchboards, as a rule, contain a larger number of ammeters than of any other type of instrument. Ammeters are frequently the only instruments on large feeder switchboards. For feeder panels it seems very clear that a high degree of accuracy is not called for, only an approximate indication of the current being required. Indeed, it may be said that current is not a quantity required to be known more than approximately in central-station work. For this reason it seems clear that a cheap type of ammeter will serve all the purposes required on the central-station switchboard. Such instruments should, of course, be dead beat; but dead-beatness, at one time confined to instruments of the moving-coil type, is now obtainable with moving-iron instruments. The accuracy of these latter instruments cannot, perhaps, be checked so easily as that of shunted ammeters; but if the resistance of the instrument is known a very good check can easily be obtained by taking the drop across the terminals of the instrument with a good, high-resistance millivoltmeter.

Switchboard voltmeters require a greater degree of accuracy than ammeters. The voltage of supply being prescribed by authority, and definite deviations only being allowed, the voltmeters connected to the feeder pilots should be of good quality. It is a good practice to have these voltmeters duplicated. One pair, in the case of three-wire systems, could be of large size, easily read some distance away, while the duplicate voltmeters could be of the electrostatic type. The accuracy of the feeder voltmeters can by this means always be kept under observation. For paralleling D.C. machines, zero-volt indicators are in common use, and the question of accuracy in the ordinary sense does not apply in the case of such instruments. They should, however, be of good construction.

Indicating wattmeters and power-factor meters on E.H.T. control switchboards are now of standard type. The degree of accuracy required with an indicating wattmeter is of the same order as that called for in a D.C. machine ammeter. Power-factor meters of modern design are very accurate. Little need be said regarding frequency meters.

The degree of accuracy desirable in integrating watt-hour meters is debatable. For ordinary purposes, on generating units, this would not seem to be very high; but, on the other hand, for purposes of steam consumption and other works tests an exceedingly good instrument is called for, if results worthy of the name are expected. Money spent on thoroughly reliable and accurate watt-hour meters for main switchboards will not, as a rule, be wasted, but will be well laid out. For D.C. work, commutator meters of the motor type have been largely used. It is essential that these be of the astatic type, owing to the considerable stray fields arising from the heavy current flowing near the meters. Mercury watt-hour meters have been used on main switchboards to a limited extent. Apart from the inherent limitations of a mercury meter, these instruments would seem to be specially unsuitable for use in an engine-room where the temperature is high, experience showing that the amalgamating action of the mercury on the copper armature disk of the meter is rapidly accelerated by heat. With meters of both the commutator and mercury types, the accuracy, apart from solid friction, depends upon the constancy of the brake magnets. No meter depending for its accuracy upon this constancy can be reckoned to be permanently accurate, and, in view of the comparative difficulty of testing and adjusting switchboard meters, it seems desirable that meters not suffering from the limitations mentioned be adopted. Aron clock meters are excellent for switchboard use, in that their calibration, depending as it does on physical constants that may be considered quite permanent, can hardly alter. Where meters of this type are used, permanent accuracy can be relied upon, provided, of course, that the meters are free from mechanical defects. Such defects, it may be remarked, are usually perceived immediately with clockmeters, as the readings of the meter become inconsistent at once, and do not alter gradually, as in the case of meters of the motor type.

Induction meters are in common use for A.C. switchboard use. These instruments now give a high degree of accuracy, and have been found very satisfactory for this purpose. For three-phase work, the usual single meter, with two elements and one spindle and counter, is usually employed. In the course of the discussion of Messrs. Ratcliff and Moore's paper on "Electricity Meters," before the Institution of Electrical Engineers, in 1911, Mr. W. B. Shaw suggested that two single-phase meters should be used for metering three-phase power on main switchboards. There is a good deal to be said for this suggestion. Although the ordinary three-phase meter for unbalanced loads will accurately integrate energy, it is, from the point of view of possibility of failure or inaccuracy through mechanical friction, only a single meter. By using two single-phase meters it is possible, in the case of failure of one of the meters, to estimate the total energy, knowing the power factor, by reason of the definite relationship existing between the ratio of the readings and the power factor when the circuit is balanced. As the average power factor can be obtained with a considerable degree of accuracy, it is possible at any time to obtain a fair check on the accuracy of the two instruments, and also to detect in good time any falling-off in the accuracy of one of them. Objection has been raised to this method on the ground that, at fairly low power factors of the whole circuit, one of the meters will be working at a power factor very much less, possibly in the neighbourhood of zero. It may be pointed out that in this case the meter working at the low power factor will be metering a very small proportion of the total energy, and even though it be working inaccurately, such inaccuracy will have but a small effect upon the accuracy of the combination. Apart from this theoretical reason, the objection is of small importance, in that usually it is possible in modern central stations to keep the power factor of the system in the neighbourhood of unity. Induction meters are, of course, subjected to the same limitations as D.C. meters of the motor type, in that they depend for their prolonged accuracy upon the constancy of the brake magnets. Meters of the Aron clock type are therefore preferable for A.C. as well as for D.C. work if the highest accuracy is desired.

In conclusion, it may then be said that ammeters or indicating wattmeters are required only to give the load on a machine or in a feeder approximately, and, therefore, do not need to be of the highest accuracy. Voltmeters, as a rule, are required to give an accurate indication, and with them a higher class construction is desirable. Integrating wattmeters give the final result of the conversion of the potential energy of the coal into electrical energy, and if the efficiency of this conversion is desired to be known with certainty, and if the performance of the generating sets be desired to be kept under close supervision, the accuracy of these instruments should be of the highest possible, and such accuracy should, apart from mechanical failure, be maintained for an indefinite time.

France.—A new company has lately been formed with a capital of £40,000, and the title La Société Tréfilerie et Cablerie, to acquire and carry on the wire and cable works of Messrs. Bailly, Chaudouet, Desvoyod & Co., at Bourg-en-Bresse (Ain).

THE CONTROL OF LARGE AMOUNTS OF POWER.

MR. E. B. WEDMORE read his paper before the MANCHESTER LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS on March 12th. An abstract of the paper appeared in the ELECTRICAL REVIEW for March 15th, 22nd, and 29th.

Mr. G. A. JUHLIN said the author had given certain values of the short-circuit current, but had not made it clear exactly what those values meant. The maximum short-circuit current indicated by the curves was 10 times the normal current. It was not clear whether the author had considered a symmetric or an asymmetric short-circuit. If the latter was the case, the values appeared to be too low. It seemed essential that some definite basis should be laid down in giving these values, for if manufacturers were asked to state short-circuit currents, and one gave the R.M.S. values and assumed a symmetric short-circuit, whereas another gave the maximum possible peak value, the latter would be approximately 2.5 times as great as the former, assuming the machines in question to have the same reactance. While he agreed that it was not at present possible to limit faults between phases, they had at least protective gear which would cut out apparatus that had failed between phases, but they were still without means of cutting out either a generator or a transformer which might develop a short-circuit between turns. It was of great importance to protect machines from destruction by fire, and a scheme with this aim in view consisted of providing dampers in the air ducts of the machine, which could be tripped automatically by the Merz-Price or any other protective gear that might be installed. The air supply would then be cut off immediately a fault occurred in the generator, and thus prevent the total destruction of the winding by fire.

Mr. A. E. MCKENZIE thought the author was right in stating that for some few years to come we should have to content ourselves in this country with generators of 20,000 and 30,000 KW. Regarding the inherent regulation of generators, to-day the power load predominated to such an extent that machines having coarse regulation and short-circuit currents of comparatively low value were preferred. Automatic voltage regulators would be found quite unnecessary. Faults on generators invariably started between turns of the same phase winding, and then went to earth before developing between phases. Every generator should be protected by balanced protective gear, with a device for disconnecting the main field immediately the main switch was opened. He was not in agreement with Mr. Juhlin as to the necessity for automatically closing the air dampers on the outlet and inlet sides of generators. Regarding the provision of a second line of defence, at Stuart Street station, during the last 10 years only in three or four cases had one of the main group switches operated, but if it had not operated there would have been a severe switchgear breakdown on each occasion. Limiting the cross-section of the smallest conductor was most important on large feeder systems.

Dr. W. CRAMP said the term "reactance" was used almost throughout the paper in a wrong sense. Obviously the author meant "impedance." The principles upon which the values given in the paper were arrived at needed explanation. The author should consider maximum currents and instantaneous conditions; whereas he seemed to assume only R.M.S. currents and steady conditions. He neglected entirely the effects due to capacity, self-induction, and leakage of the line. The important function of the impedance in enabling the oil switch to open the circuit was neglected by Mr. Wedmore, although it was of great importance in deciding the amount of impedance desirable. With regard to the use of chokers containing iron, had the author ever considered the possibility of a core with an air-gap so arranged that when the current exceeded a pre-determined figure the gap would close, and a much larger reactance be automatically put in circuit? Also, had he any knowledge of the use of Hilliard's switch, which on the occurrence of a short-circuit put a choker into operation?

Mr. J. DENHAM asked what was the number of K.V.A. actually broken in an oil switch relatively to the K.V.A. produced by the generator. Was it too much to expect from the users of medium and large oil switches that on the occasion of a short-circuit they might note the particulars needed to arrive at the approximate value of the short-circuit? If this information, together with details of the type of switch, were sent to the manufacturer, he could fill in other details, and the whole of such records over, say, a year or so, published by the Institution (with the consent of users and manufacturers) would prove of the utmost benefit.

Mr. W. DE M. LANDON asked whether it was not time, in large cities, to construct subterranean passages where feeders could be inspected from time to time, and where an inspector could travel equally as freely as if on the street surface. He agreed with Dr. Cramp on the question of reactances.

Mr. S. FERGUSON said reactances were destined to play a very important part in the large schemes now contemplated. He thought a combination of generator, feeder, and bus-bar reactances would be the ultimate scheme adopted in large stations. He showed curves illustrating the effects of bus-bar reactances in a medium-sized station by which it was seen that the adoption of 12½ per cent. reactance reduced the initial energy output and the initial short-circuit current to about one-half, thus reducing the mechanical stresses to one-quarter. This result was accomplished with reactances having an energy loss of about 3 KW. for each single-phase unit. The cost was only 3 to 4 per cent. of the capital value of the plant, and the space occupied for each coil about 5 ft. diameter and 4 ft. high. It was evident that a very big insurance of the plant was effected at comparatively small cost. All engineers should get to know what was the average inherent reactance of their plant, and forward that information to their switchgear suppliers, so that they might estimate what initial short-circuit current might be expected at any particular point in the system. He thought that in switching a transformer in and out of circuit it was desirable whenever possible to energise it and de-energise it on the low-tension side. He hoped that ere long they would have British rules for oil switches which would guide purchasing engineers in their selection for any particular duty. German rules had existed for a number of years, but they were out of date in that they ignored some very important factors.

Mr. J. L. THOMPSON thought the author had had very little experience of the ironclad reactance, or he would not have made such a sweeping statement as that "there is no gain in the use of iron in the design." The straight line characteristic up to maximum possible fault current was attained in the ironclad type. The chief claim made for the air-core reactance was that it had a straight line characteristic; while this was true, it had possible disadvantages. In comparison, the ironclad type had no stray field, and hence could be oil insulated and mounted in a tank, and could be placed in any position that a transformer could occupy. It could be placed adjacent or underneath the generators, thus reducing cable runs to a minimum. Much less floor space was required, and it was a safe and open piece of apparatus, since the tank could be earthed. This type had also a very heavy overload capacity. This type could have a threefold safety factor; for the windings were insulated from the core, the core could be insulated from the tank, and the latter could be mounted on insulators in a similar way to the air-core type. For bus-bar work the ironclad was the cheaper proposition as regarded cost of coils, floor space, and cable runs. For generator work the cost of coils became more nearly equal, but the advantage of floor space and economy in cable rested with the ironclad type. For feeder work, the air-core type was cheaper, but this advantage must be weighed against floor space and the safety of the employé.

Mr. H. A. RATCLIFF said the author made out a very strong case for the use of reactances, but nevertheless he thought it was a mistake to regard them as the panacea for all the troubles incidental to the operation of a high-tension electricity supply system. With regard to location, he thought a certain amount of external reactance in the generator circuits was beneficial. For the same total amount of reactance in the circuit, and, therefore, the same current-limiting conditions, the possible mechanical strain on the generator windings would be less when some of the reactance was external. The most suitable location for these reactances was probably between the bus-bar sections, and no doubt ultimately that was where they would mainly be used. He did not consider that they were any advantage in the feeders, and, in fact, they might be a positive disadvantage. He questioned whether such a form of protection was necessary in feeders, and he was inclined to think that the money spent on feeder reactances would be employed to better advantage in putting the very best possible work and materials into the cable joints and the switches at the far ends of the lines. It was a very interesting feature of the concrete-supported coils that should high-frequency surges occur in the circuit, the concrete acted as a high-resistance non-inductive shunt. He would like to know whether the reference to it was anticipation, or whether it had actually been known to occur. His experience of pyro-electric conductors was that a very small current sustained for a very short time produced intense heating, frequently with disruptive effects. He was in agreement with the author as regarded the ironless form of construction. The design and construction of some current transformers was distinctly bad, and they were undoubtedly in many cases the weakest link in a supply system. He agreed with the author that they should be made with the largest possible section of conductor consistent with reliability and accuracy in the duties they had to perform.

Mr. A. G. ELLIS said that regarding the protection of large units against deleterious effects of short circuits, the whole question amounted to one of reactance. From the point of view of the transformers, external reactance was really preferable, as it resulted in lower stresses in the transformer under short circuit. The internal reactance of modern large power transformers was as high as 5, 6, or 7 per cent. This, with the inherent reactance of the generators, was usually sufficient to obviate the necessity for external reactances. These were more usually required in cases of extension of existing generating stations to cope with the increasing demands. The author's statement that "there is no gain in the use of iron" in reactances certainly needed qualification. One of the chief gains in the ironclad type was that the magnetic field was confined to the core, and there was no stray field as in the air-core type. It was just in cases where the space available was cramped, as was often the case in extensions, that this consideration was of importance. The apparatus

was in itself practically a transformer with one winding. There were certain cases of large reactances where forced air-blast cooling must be adopted for the air-core type. The ventilating fan and motor added another link in the chain of auxiliaries, which reduced the safety factor of operation. The magnetisation of the core at normal current and normal choke was so low that the core loss was negligible.

Mr. W. A. COATES said the ordinary inverse time-limit relay had a curve of operation such that on large overloads, it acted practically instantaneously, and thus selective action was impossible. Some four years ago a relay was patented in this country combining the advantages of the inverse time-limit relay with that of the fixed time-limit relay (Coates and Ferranti, Ltd., No. 29,861, 1913). About the same time in America the Westinghouse Co. produced an instrument having similar characteristics, although the principle of operation was entirely different. It was necessary to allow a sufficient margin of time between adjacent relays to ensure that the contacts on the oil switch nearest to the fault had properly opened. On modern switches this time would be of the nature of 0.15 to 0.2 sec. A similar device working in conjunction with a wattmeter relay movement with very fine settings was employed for use on duplicate feeders, ring mains, and similar systems, so that all ordinary systems of connection could be properly protected with these selective relays. Regarding the rupturing capacity of oil switches, on modern switches length of break was not so much a variable depending on the K.V.A. capacity as one which changed with the normal voltage. It was only within the last few years that the value had been properly appreciated of a large head of oil, and also of an ample air space above the oil.

Mr. E. B. WEDMORE, in reply, said the whole subject of the rupturing capacity of oil switches was under consideration by committees dealing with standardisation, and he hoped that their work would result in the issue of information giving more detail. The design of protective devices able to disconnect a partially short-circuited winding presented considerable difficulty. They had a partial solution, due to Messrs. Witcher and Clough, fortunately applicable to very heavy machines where these had two or more windings per phase in parallel. The balance of current between the parallel windings was upset if one winding became partially short-circuited, and they could utilise this to cause disconnection of the machine. He had not suggested that modern switchgear was "absolutely" reliable; his term was "non-speculative." If step-up transformers were associated with individual feeders rather than individual machines, they must be employed at a lower load factor. With large amounts of power this involved serious losses, so that economy compelled them to face the problems arising out of switching at the higher voltage. In saying that "there is no gain in the use of iron," he was not suggesting that there was nothing to put on the credit side of the balance-sheet, but some of the items some of the speakers had endeavoured to put there would be queried by the auditors. He did not follow Mr. Thompson in his argument that there was less fire risk in a design employing large quantities of inflammable material, including oil, than in one constructed throughout of incombustible material and housed in a fire-proof chamber. It was not easy to demonstrate that high-frequency disturbances had been absorbed by a reactance with concrete frame in any particular case, but calculation showed that the leakage paths afforded by the concrete were likely to be helpful in dealing with temporary high-frequency phenomena. There was no danger from pyro-electric effects with the proportions employed. He did not follow Mr. Coates's remarks on oil-switch designs. At any voltage the rupturing capacity increased with length of break according to a certain law; within wider limits than might be expected they could vary the relative dimensions of head of oil, length of break, and air buffer without modifying the rupturing capacity materially, and thus it was open to them to choose dimensions which were convenient for manufacture, and for obtaining other desirable features, such as speed of break, and in the arrangement of the parts. As soon, however, as those limits of proper proportion were exceeded the design quickly deteriorated.

TWO ESSENTIAL CONDITIONS FOR BURNING TAR OIL IN DIESEL ENGINES.

By MR. P. H. SMITH.

(*Abstract of paper read before the* DIESEL ENGINE USERS' ASSOCIATION.)

Two main factors, atomisation and turbulence, are essential and cannot be disassociated if really satisfactory running is to be achieved with the use of refractory fuel oils. Atomisation refers to the degree of fineness of the spray at the moment it leaves the flameplate or in the immediate proximity thereof. Turbulence refers to the degree of swirling occurring in the combustion space as the fuel enters the cylinder. It produces a commotion and agitation resulting in a more or less intimate mixing of the fuel and air according as turbulence is more or less vigorous. Efficient atomisation, but without vigorous turbulence, possesses the following disadvantages:—The safe full load rating of the engine must be reduced; the thermal efficiency at large loads is reduced and, therefore, the fuel consumption is high; the operation of the engine is limited to the better qualities of refractory fuel oils. At light loads efficient pulverisation and very little turbulence are desirable, or the mixture may become too dilute to burn.

In the normal Diesel fuel valve, comprising a ring pulveriser, fluted cone and flameplate with rounded orifice, they had a device resulting in deficient pulverisation but ideal turbulence. Atomisation was deficient because the spray issuing from the flameplate was decidedly wet, and this arose through coalescence occurring between the top of the cone and the aperture of the flameplate. Probably at the moment it entered the flutes of the cone the spray was as perfect as that associated with the solid injection system. But on entering the flutes of the cone it lost its confused motion, and settled into regular stream lines, with the result that coalescence commenced on the walls of the flutes and on the sides of the fuel valve. It finally left the rounded orifice of the flameplate to which the coalesced oil adhered, and the resultant spray entering the cylinder was very wet.

Turbulence with the standard fuel valve was excellent. The concave piston head assisted turbulence by ensuring a good whirling action in the space between the piston and the cover, thus intimately mixing the fuel and air. With the normal Diesel fuel valve operating under favourable conditions, a mean effective pressure of 150 lb. per square inch could be obtained with a perfect exhaust, notwithstanding imperfections of atomisation.

At least two known systems of pulverising oil gave what must be an almost perfect spray. In the solid injection system the spray was so finely divided that it scarcely moistened or discoloured an object passing through it. The other he had in mind originated from the whirling spray in its various forms. Yet either applied to Diesel engines, whatever the fuel, was deficient because the other important factor, turbulence, was absent in the solid injection and inadequate in the whirling spray. In the solid injection the fuel was impelled into the cylinder under a hydraulic pressure of 4,000 to 5,000 lb. per square inch, but as no blast air followed the fuel, it was obvious that turbulence was practically non-existent. Hence such engines were over-rated at 100 lb. M.E.P.

In the whirling spray turbulence was much less pronounced than with the standard Diesel fuel valve. Thus, if an engine of about 12-in. bore was worked long hours at about ¾-load for a week or two, it would be found that there was a well-defined hot zone, about ¾ in. wide, concentric with the piston, and at a mean radius from the centre of about 2½ in. In this zone the metal burned and fused into globules the size of a pin head. If turbulence were vigorous the heat would be dissipated more uniformly throughout the combustion space, and the flame would not be able to concentrate itself locally. Suppose the compressor was becoming rather weak, and with the normal fuel valve would pump up to a maximum of about 850 lb. per square inch only. Then suppose the engine was adjusted with a whirling spray flameplate, it would be found that the compressor could deliver air at a much higher pressure, 1,000 lb. per square inch, for example. This showed that the whirling spray passed a smaller quantity of blast air than the normal fuel valve, and as the whirling spray was diffused whereas the normal jet was concentrated, it followed that turbulence was less with the former than the latter. The form assumed by the whirling spray in its best development was that of a hollow paraboloid. It could be shown that inside the paraboloid very little commotion existed. In the Diesel cylinder the air contained inside this paraboloid was the most valuable for combustion purposes, but because there was so little turbulence at this part, the whirling spray system as they now knew it must remain at a disadvantage where heavy loads were wanted. With the whirling spray an engine might be set to run on tar oil at ¼ to ½ load with a blast pressure of 800 lb. per square inch, and the engine would run without missing. If turbulence were as violent as with the ordinary fuel valve, so high a blast pressure would cause this small quantity of fuel to become too dilute to burn. Under the same pressure difference, and tried in open atmosphere, the jet from the normal Diesel fuel valve carried 10 to 15 times further across the room than the jet from the whirling spray. In the latter, increasing the pressure served merely to open the angle formed by the spray. The relatively high fuel consumption at about 100 lb. M.E.P., and the difficulty of clearing the exhaust, pointed to inefficient mixing of the fuel and air in the cylinder, whence, by inference, insufficient turbulence.

With the introduction of tar oil for Diesel engines, the first device they adopted was a flameplate with a sharp-edged orifice in place of the normal flameplate with the rounded aperture. To this the coalesced fuel could not so readily cling, and there was a marked reduction in the wetness of the spray; the safe minimum load on tar oil was reduced about 20 per cent. without sacrificing turbulence or advantages at heavy loads. Tabulating the different systems under discussion in order of merit as regards pulverisation, the comparison being made according to the dryness of the spray, he would place them thus:—Solid injection; whirling spray;

sharp-edged orifice, rounded orifice. And in order of turbulence thus:—Sharp-edged orifice; rounded orifice; whirling spray; solid injection.

From the foregoing analysis it was deduced that the whirling spray system would be greatly improved if a means could be found to increase its turbulence without disturbing its pulverising properties.

The normal Diesel fuel valve being satisfactory for heavy loads and unsatisfactory on light loads, it followed from the above analysis that improvement should be sought in perfecting the method of pulverisation. In the system associated with his firm's name this was achieved by pulverising the fuel closer to the cylinder and introducing violent turbulence at the needle point, and then treating the subsequent coalescence in the flameplate itself in such a manner that liquid particles of fuel were re-converted into spray. The resultant stream passing into the cylinder was remarkably dry and homogeneous, and thus achieved light-load running satisfactorily without sacrificing heavy load advantages.

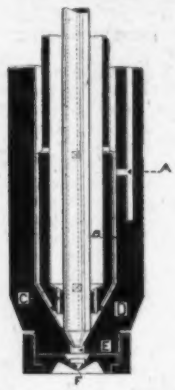


FIG. 1.—SLEEVE PULVERISER SYSTEM FOR BURNING TAR OILS.

The sleeve pulveriser was merely a device for preventing intimate mixing of fuel and blast air until it was desired to effect pulverisation. It supplied a means of delaying pulverisation until the flameplate was nearly reached, whence the mixture was passed at high velocity to the cylinder, its speed rendering the apparatus self-cleaning.

In the diagram, fuel enters at *A* and settles round the outside of the sleeve, where it is subject to maximum blast pressure which, when the needle opens, forces it down the outside of the sleeve and past the restriction *D*, which reduces the oil to film form. The major quantity of blast air impinges on this film with violence as it issues from holes *C*. This reduces the film to spray form, but coalescence commences in passage *E*. The liquid portion so produced is forced into groove *F*, and is there disintegrated again as set forth above.

The hypothesis upon which they designed their sleeve pulveriser was that the choking of the ring type resulted from oxidisation of the fuel, which released free carbon. Conditions for this were ideal in the ring type. In its passage through the rings the oil was beaten into a fine spray, thus presenting an enormous area to the oxidising influence of the blast air at 800 to 900 lb. pressure. The sleeve type of pulveriser overcame this difficulty, and whether the explanation he gave was scientifically correct or not was a matter of small moment to him, as he was no chemist; the hypothesis when applied worked out right, and their sleeve pulverisers, properly designed, did not choke.

NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

8,727. "Means for operating electromagnetic release gears for use on aircraft." A. W. JUDGE. May 27th.

8,740. "Preventing rapid exhaustion of primary batteries." T. MCLEOD. May 27th.

8,749. "Terminal for attachment of magnetic wires to sparking plugs of engines." E. MARAZZI. May 27th. (Italy, March 21st, 1917.)

8,755. "Apparatus for direct conversion of energy of motion of a dielectric into electric energy, and conversely for conversion of electric energy into the motion of mass." May 27th.

8,761. "Electro-converter furnaces, and process of treatment for manufacture of steels thereby." P. F. SARRON & J. SIMON. May 27th.

8,779. "Variable-circuit electric motor." F. H. ROBINSON. May 28th.

8,780. "Semi-automatic electric welding device for welding iron or steel studs to plating, &c." A. E. FRANKLING. May 28th.

8,792. "Automatic speed-limit apparatus for electrical machinery." C. W. COLLINS. May 28th.

8,793. "Trolley-heads of overhead electric vehicles." C. W. COLLINS. May 28th.

8,811. "Overload switches." P. G. VAN WIJK. May 28th. (Holland, March 7th.)

8,819. "Alternating-current protective devices." G. KAPP. May 28th.

8,846. "Sparking plugs for internal-combustion engines." J. E. BARROWS. May 29th.

8,867. "Electrically-heated perforator." A. B. CAMPBELL. May 29th.

8,870. "Electric transformers." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) May 29th.

8,881. "Ignition devices." F. W. VICKERY. May 29th.

8,883. "Magneto-electric machines." S. EVERSHED & EVERSHED AND VIGNOLES. May 29th.

8,884. "Electromagnetic devices." G. PLAISANT. May 29th.

8,933. "Electric milk steriliser." D. SUCHOSTAWER. May 30th.

8,936. "Incandescent electric lamps." OSRAM-ROBERTSON LAMP WORKS AND T. J. SACK. May 30th.

8,941. "Dynamo-electric machinery." J. W. BURLEIGH. May 30th.

8,953. "Self-regulating continuous-current dynamo." A. H. MIDGLEY AND C. A. VANDERVELL. May 30th.

8,978. "Electric fuse carriers." A. C. CHECKETTS & A. C. ROBINSON. May 31st.

8,998. "Regulating arrangements for electric circuits, chiefly for controlling dynamo-electric machinery." J. C. WATSON. May 31st.

9,003. "Magneto-electric machines." BRITISH THOMSON-HOUSTON CO. AND A. P. YOUNG. May 31st.

9,016. "Electric spark-gaps." M. L. MAGNETO SYNDICATE & E. A. WATSON. May 31st.

9,018. "System of distributing electric energy." C. H. WORDINGHAM. May 31st.

9,021. "Windings in electrical apparatus." BRUSH ELECTRICAL ENGINEERING CO. & P. W. SCHOLFIELD. May 31st.

9,023. "Electric torches." EFANDEM CO. & F. J. J. GIBBONS. May 31st.

9,025. "Primary batteries and manufacture thereof." G. WALLACE. May 31st.

9,028. "Treatment of refractory metals." EDISON SWAN ELECTRIC CO. May 31st.

9,056. "Electrical installations." L. JOUBERT. June 1st. (France, June 4th, 1917.)

9,068. "Detector for wireless telegraphy." M. COMPARE & COMPARRE WIRELESS CONTROL SYNDICATE. June 1st.

9,074. "Means for controlling electric circuits." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) June 1st.

9,075. "Alternating-current dynamo-electric machines." BRITISH THOMSON-HOUSTON CO., H. W. TAYLOR & J. WHITCHER. June 1st.

9,082. "Interlocking plug switches." H. STOKES. June 1st.

PUBLISHED SPECIFICATIONS.

The numbers in parenthesis are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

117. ELECTROLYTIC APPARATUS FOR THE GENERATION OF OXYGEN AND HYDROGEN. I. H. Levin. June 3rd, 1916. (107,366.)

5,009. CONTROLLING THE CURRENT IN CONNECTION WITH ELECTRO-MAGNETIC GEAR BOXES OF AUTOMOBILES. Wolseley Motors, Ltd., & T. Wardell. April 10th, 1917. (115,458.)

6,508. HIGH-FREQUENCY ALTERNATING-CURRENT DYNAMOS. Crompton & Co. and N. Pensabene. May 8th, 1917. (155,475.)

6,556. FUSIBLE ELECTRIC CUT-OUTS. British Thomson-Houston Co. & E. B. Wedmore. May 8th, 1917. (115,478.)

6,558. SOUND BOXES FOR SOUND-PRODUCING MACHINES. H. T. Logan and Universal Music Co May 8th, 1917. (115,481.)

6,584. ELECTROMAGNETICALLY-OPERATED BRAKE MECHANISM FOR CRANES OR THE LIKE. Ransomes & Rapier and R. S. Lewis. May 9th, 1917. (115,485.)

7,354. SELF-REGULATING DYNAMO-ELECTRIC MACHINES. W. Holt & B. Brooks. May 22nd, 1917. (115,509.)

7,718. RECTIFYING INTERRUPTERS FOR X-RAY PURPOSES. A. E. Dean. May 30th, 1917. (115,518.)

8,198. MOTOR-CAR LIGHTS AND LAMPS. E. R. Rysman. June 8th, 1917. (115,519.)

9,092. CONTROL MECHANISM FOR THE ELECTRICAL FITTINGS OF MOTOR VEHICLES. R. W. Maudslay & Standard Motor Co. June 25th, 1917. (115,532.)

11,079. SECONDARY ELECTRIC BATTERIES OR ACCUMULATORS. Chloride Electrical Storage Co. & H. Dean. August 1st, 1917. (115,551.)

12,414. FITTINGS FOR ELECTRIC LAMP SHADES, REFLECTORS, AND THE LIKE. F. A. Reynolds & A. Reynolds. August 29th, 1917. (115,561.)

12,478. CONTROL SYSTEMS FOR ELECTRIC MOTORS. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.) August 30th, 1917. (115,563.)

12,480. PHASE-BALANCERS OR PHASE-CONVERTERS FOR POLYPHASE DISTRIBUTING SYSTEMS. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.) August 30th, 1917. (115,564.)

13,286. ELECTRICAL SYSTEM FOR ELECTRIC FURNACES. T. H. Watson & Co., H. A. Greaves & H. Etchells. September 17th, 1917. (115,570.)

16,849. MEANS FOR COOLING THE COLLECTOR RINGS OF DYNAMO-ELECTRIC MACHINES. Svenska Turbinfabriks Aktiebolaget Ljungström. August 6th, 1917. (115,878.)

16,916. METHOD OF ASSEMBLING THE ARMATURE PLATES IN MAGNETOS HAVING A FIXED ARMATURE. E. C. R. Marks (Soc. Anon. des Etablissements L. Bleriot). December 18th, 1916. (Divided application on 18,144/16.) (115,379.)

16,917. METHOD OF FIXING THE ARMATURE IN MAGNETOS HAVING A FIXED ARMATURE. E. C. R. Marks (Soc. Anon. des Etablissements L. Bleriot). December 18th, 1916. (Divided application on 18,144/16.) (115,380.)

16,975. ELECTRIC-IGNITION DISTRIBUTORS FOR INTERNAL-COMBUSTION ENGINES. H. W. F. Ireland. November 18th, 1917. (114,990.)

17,335. ELECTRICAL SIGNALLING SYSTEMS. Sterling Telephone & Electric Co., F. G. Bell & W. C. Davey. May 8th, 1917. (Divided application on 6,542/17.) (115,590.)

17,769. ELECTRIC FLASHLAMPS. M. Goodfellow & British Ever-Ready Co. November 30th, 1917. (115,381.)

18,070. ELECTRIC SIGNALLING SYSTEMS. Sterling Telephone & Electric Co., F. G. Bell & W. C. Davey. June 12th, 1917. (Divided application on 8,416/17.) (115,594.)

18,216. ALTERNATING-CURRENT RELAYS. Waygood-Otis, Ltd. (Otis Elevator Co., U.S.A.) December 8th, 1917. (115,595.)

18,502. TELEPHONE SYSTEMS. Automatic Telephone Manufacturing Co. January 8th, 1917. (112,774.)

1918.

831. STREET AND STATION INDICATORS. W. Clark (F. B. Robinson). January 14th, 1918. (115,394.)

1,539. ELECTRIC ATTACHMENT PLUGS. W. Hunt (Bryant Electric Co. U.S.A.) January 26th, 1918. (115,608.)

5,230. ELECTRIC COUPLINGS. H. de la Valette. March 28th, 1918. (Addition to 105,227.) (114,429.)

3,408. ELECTRIC LIGHT FITTINGS. E. R. Hough & L. Harrison. February 26th. 1918. (Addition to 2,928/15.) (115,400.)